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cence the flowers are properly lateral upon the main axis, or the secondary axes. The flowers develop in acropetal (centripetal) order, and when the axis continues to grow the cluster may become indefinitely extended, whence it is called *indeterminate*. In Cymose inflorescence every flower is properly terminal upon a main axis or one of the secondary ones. In every flower cluster the main axis is first terminated by a flower; lateral branches (secondary axes) then arise at some distance below the apex, and each of these is terminated by a flower; lateral branches terminated by flowers arise on the secondary axes, and so on. The flowers thus develop in basipetal (centrifugal) order. From the fact that every axis is terminated by a flower, such clusters are often called *determinate*. This distinction into indeterminate and determinate is, however, a misleading one, for some botryose inflorescences are in fact determinate—*e.g.*, the Umbel and Head; while, on the other hand, most of the cymose flower clusters are capable of indefinite extension, as is notably the case with the Helicoid and Scorpioid forms. It not infrequently happens that in large flower clusters a part of the branching is of one type and the remainder of the other; all such cases may be considered as examples of *mixed* inflorescence.

The most important of the terms in common use are given in the following table of inflorescences:

#### A. BOTRYOSE INFLORESCENCE.

##### I. Flowers solitary in the axils of the leaves—

*e.g.*, *Vinca*.....**Solitary Axillary.**

##### II. Flowers in simple groups.

###### 1. Pedicellate.

(a) On an elongated axis: pedicels about equal—*e.g.*, *Mignonette*.....**Raceme.**

(b) On a shorter axis; lower pedicels longer—*e.g.*, *Hawthorn*.....**Corymb.**

(c) On a very short axis; pedicels about equal—*e.g.*, *Cherry*.....**Umbel.**

###### 2. Sessile.

(a) On an elongated axis—*e.g.*, *Plantain*.**Spike.**

Var.  $\beta$ . Drooping, and scaly bracted—

*e.g.*, *Poplar*.....**Catkin.**

Var.  $\gamma$ . Thick and fleshy—*e.g.*, *Indian*

*Turnip*.....**Spadix.**

(b) On a very short axis—*e.g.*, *Clover*...**Head.**

##### III. Flowers in compound groups.

###### 1. Regular.

(a) Racemes in a raceme—*e.g.*, *Smilacina*.**Compound Raceme.**

(b) Spikes in a spike—*e.g.*, *Wheat*.....**Compound Spike.**

(c) Umbels in an umbel—*e.g.*, *Parasnip*..**Compound Umbel.**

(d) Heads in a raceme—*e.g.*, *Ambrosia*... **Heads Racemose.**

(e) Heads in a spike—*e.g.*, *Liatris*..... **Heads Spicate.**

And so on.

## 2. Irregular.

Racemosely or corymbosely compound—

*e.g.*, *Catalpa* ..... **Panicle.**

Compound forms of the panicle itself are common—*e.g.*, *panicled heads* in many Compositæ, *panicled spikes* in many grasses.

## B. CYMOSE INFLORESCENCE.

I. Flowers solitary; terminal—*e.g.*, *Anemone*

*nemorosa*..... **Solitary Terminal.**

II. Flowers in clusters (Cymes).

1. Lateral branches in all parts of the flower

cluster developed—*e.g.*, *Cerastium*..... **Forked Cyme, or Dichasium.**

(This is the *Biparous*, and so-called *Dichotomous Cyme* of authors.)

2. Some of the lateral branches regularly suppressed.

(a) The suppression all on one side—*e.g.*,

*Heimerocallis*..... **Helicoid Cyme, or Bostryx.**

(b) The suppression alternately on one

side and the other—*e.g.*, *Drosera*... **Scorpioid Cyme, or Cicinnus.**

(The last two are frequently not distinguished from one another, and are called *Monochasia*, *Uniparous Cymes*, or *Faise Racemes*.)

## C. MIXED INFLORESCENCE.

1. *Cymo-Botryose*, in which the primary inflorescence is botryose, while the secondary is cymose, as in *Horsechestnut*... **Cymo-Botrys.**

(This is sometimes called a *Thyrus*.)

2. *Botryo-Cymose*, in which the primary inflorescence is cymose, while the secondary is botryose—*e.g.*, in many *Compositæ*..... **Botry-Cyme.**

**Floral Symmetry.**—The parts of the flower are mostly arranged in whorls, which are distinctly separated from each other (*cyclic* flowers); in some cases they are arranged in spirals, with, however, a distinct separation of the different groups of organs (*hemicyclic* flowers); in still other cases the arrangement is spiral throughout, with no separation of the groups of organs (*acyclic* flowers).

In cyclic flowers there are most frequently four or five whorls, viz. :

1. The *Calyx*, composed of (mostly) green *sepals*.
2. The *Corolla*, composed of (mostly) colored *petals*.
3. (4.) The *Andræcium*, composed of one or two whorls of *stamens*.
- 4 or 5. The *Gynæcium*, composed of *carpels*.

These whorls usually contain definite numbers of organs in each ; in many cases the numbers are the same for all the whorls of the flower (*isomerous* flower) ; when the numbers are different the flower is said to be *heteromerous*.

The terms which denote these numerical relations are : *monocyclic*, applied to a flower having only one cycle ; *bicyclic*, two cycles ; *tricyclic*, three cycles ; *tetracyclic*, four cycles ; *pentacyclic*, five cycles, etc. ; *monomerous*, applied to flowers each cycle of which contains one member ; *dimerous*, two members ; *trimerous*, three members ; *tetramerous*, four members ; *pentamerous*, five members.

These relations can be briefly indicated by using symbols and constructing floral formulæ, as follows :

Ca<sub>5</sub>, Co<sub>5</sub>, An<sub>5</sub>, Gn<sub>5</sub> = a tetracyclic pentamerous flower ;

Ca<sub>5</sub>, Co<sub>5</sub>, An<sub>5</sub> + 1, Gn<sub>5</sub> = a pentacyclic trimerous flower.

Most commonly the members of one whorl alternate with those of the whorls next above and below ; in a few cases, however, they are opposite (or superposed) to each other. These relations may be indicated by a modification of the floral formulæ given above, as follows, where the members are alternate :

Gn	—	—	—	—	—
An	—	—	—	—	—
An	—	—	—	—	—
Co	—	—	—	—	—
Ca	—	—	—	—	—
B	—	—	—	—	—

When they are opposite the arrangement is as follows :

Gn	—	—	—	—	—
An	—	—	—	—	—
Co	—	—	—	—	—
Ca	—	—	—	—	—
B	—	—	—	—	—

In both these formulæ the position of the parts of the flower with respect to the flowering axis is indicated by the position of the bract B, which is always on the anterior side, while the axis is always posterior.

When all the members on each whorl are equally developed, having the same size and form, the flower may be vertically bisected in any plane into two equal and similar halves ; it is then *actinomorphic* (= regular, and polysymmetrical). When the members in each whorl

are unlike in size and form, and the flower is capable of bisection in only one plane, it is *zygomorphic* (= irregular, and monosymmetrical). In the latter there is generally more or less of an *abortion* of certain parts—i.e., one or more of the sepals, petals, stamens, or pistils are but partially developed, appearing in the flower as rudiments only. Sometimes this is so marked as to result in the complete *suppression* of certain parts.

It not infrequently happens in both actinomorphic and zygomorphic flowers that entire whorls are suppressed; this gives rise to a number of terms, as follows:

When all the whorls are present (not necessarily, however, *all members* of all the whorls) the flower is said to be *complete*; when one or more of the whorls are suppressed, the flower is *incomplete*.

As to its perianth, the flower is said to be

*Dichlamydeous*, when both the whorls of the perianth are present;

*Monochlamydeous*, when but one (usually the calyx) is present;

*Apetalous*, when the corolla is wanting;

*Achlamydeous*, or *naked*, when both calyx and corolla are wanting;

As to its sexual organs, the flower is

*Bisexual* (or *hermaphrodite*) when stamens and pistils are present;

*Unisexual*, when, of the essential organs, only the stamens are present (then *staminate*), or only the pistils (then *pistillate*);

*Neutral*, when both stamens and pistils are wanting;

Collectively, bisexual flowers are said to be *monöcious*; unisexual flowers, *diclinous*; while in those cases where some flowers are bisexual and others unisexual they are, as a whole, said to be *polygamous*.

Diclinous flowers are further distinguished into

*Monöcious*, when the staminate and pistillate flowers occur on the same plant, and

*Diöcious*, when they occur on different plants.

**The Perianth.**—In a large number of flowers the parts of the calyx and corolla (sepals and petals) are distinct—i.e., not at all united to one another; such are said to be *chorisepalous*\* as to the calyx, and *choripetalous* as to the corolla. The terms *polysepalous* and *polypetalous* are the ones most commonly used in English and American books on botany, although they manifestly ought to be used as numerical terms. *Eleutheropetalous*† and *dialypetalous*‡ are also somewhat used, especially in German works.

The numerical terms usually employed are *mono*-, § *di*-, *tri*-, *tetra*-,

\* From Greek χωρίζειν, to sever, to separate.

† From Greek ελεύθερος, free.

‡ From Greek διαλύειν, to part asunder.

§ The terms *monösepalous* and *monöpetalous* were formerly used with a different meaning from that given here; they were applied to the forms now called *gamosepalous* and *gamopetalous*. This use, errone-



*penta-sepalous*, etc., and *mono-, di-, tri-, tetra-, penta-petalous*, etc., meaning of one, two, three, four, five sepals or petals respectively. *Polyssepalous* and *polypetalous* are properly used to designate "a considerable but unspecified number" of sepals or petals.\*

In some flowers the sepals or petals, or both, are united to one another, so that the calyx and corolla are each in the form of a single tube or cup. This union of similar parts is called *coalescence*. The terms *gamosepalous*† and *gamopetalous* (or *sympetalous*) are used in such cases. *Monosepalous* and *monopetalous*, still used in this sense in many descriptive works, should be reserved for designating the number of sepals or petals in calyx and corolla respectively.

Not infrequently the calyx and corolla are connately united to each other for a less or greater distance. This union of dissimilar whorls is termed *adnation*, and the calyx and corolla are said to be *adnate* to each other.

**The Andrœcium.**—The number of stamens in the flower or the andrœcium is indicated by such terms as

*Monandrous*, signifying of one stamen;

*Diandrous*, of two stamens;

*Triandrous*, of three stamens;

*Tetrandrous*, of four stamens—when two of the stamens are longer than the other two, the andrœcium is said to be *didynamous*;

*Pentandrous*, of five stamens;

*Hexandrous*, of six stamens; when four are longer than the remaining two, the andrœcium is said to be *tetradynamous*.

Other terms of similar construction are used, as *heptandrous*, seven stamens; *octandrous*, eight; *enneandrous*, nine; *decandrous*, ten; *dodecandrous*, twelve; and *polyandrous*, many or an indefinite number of stamens.

The stamens may be in a single whorl (*monocyclic*), in which case, if agreeing in number with the rest of the flower, the andrœcium is said to be *isostemonous*; they are often in two whorls (*bicyclic*), and when each whorl agrees with the numerical plan of the flower, the andrœcium is *diplostemonous*.

The various kinds of coalescence require the use of special terms. When there is a coalescence of the filaments the andrœcium is

*Monadelphous*, when the stamens are united into one set;

*Diadelphous*, when united into two sets;

*Triadelphous*, when united into three sets, etc.

ous as it obviously is, has not yet been abandoned in works on descriptive botany.

\* Dr. Gray throws the weight of his authority in favor of this use of these terms ("Structural Botany," 1879, p. 244).

† From Greek *yámos*, union.

When there is a coalescence of the anthers the andrœcium is *syngenesious* or *synantherous*.

The stamens may be adnate to the petals, when they are *epipetalous*; in some cases they are adnate to the style of the pistil, as in the Orchids; such are said to be *gynandrous*.

The principal terms which designate the structural relation between the anther and filament in individual stamens are:

*Adnate*, applied to anthers which are adherent to the upper or lower surface (anterior or posterior) of the filament; when on the upper surface the anthers are *introrse*; when on the lower, *extrorse*.

*Innate*, applied to anthers which are attached laterally to the upper end of the filament, one lobe being on one side, the other on the opposite one. The part of the filament between the two anther-lobes is designated the *connective*; it is subject to many modifications of form, and often becomes separable by a joint at the base of the anther from the rest of the filament.

*Versatile* is applied to anthers which are lightly attached to the top of the filament, so as to swing easily; these may also be *introrse* or *extrorse*.

**The Gynœcium.**—The Gynœcium is made up of one or more *carpels* (*carpids* or *carpophylla*)—*i.e.*, ovule-bearing phyllomes, and it is said to be *mono-*, *di-*, *tri-*, *tetra-*, *penta-*, etc., and *poly-carpellary*, according as it has one, two, three, four, five, to many carpels. In old books the terms *monogynous*, *digynous*, *trigynous*, etc., meaning of one, two, three, etc., carpels, are used instead of the more desirable modern ones. When the carpels are more than one they may be distinct, forming the *apocarpous* gynœcium; or they may be coalescent into one compound organ, the *syncarpous* gynœcium. In the former case the term *pistil* is applied to each carpel, and in the latter to the compound organ. Pistils are thus of two kinds, *simple* and *compound*; the simple pistil is synonymous with carpel; the compound pistil with syncarpous gynœcium.

In the simple pistil the ovules actually grow out from the united margins (the *ventral suture*) of the carpophyllum; the internal ridge or projection upon which they are borne is the *placenta*. Sometimes the ovules are *erect*—*i.e.*, they grow upward from the bottom of the ovary—and when single appear to be direct continuations of the flower axis (Fig. 304). *Suspended ovules*—*i.e.*, those growing from the apex of the ovary cavity—are also common.

In compound pistils the coalescence may be, on the one hand, of closed carpels, and on the other of open carpels. In the former case the pistil has generally as many *loculi* (cavities or cells) as there are carpels; this is expressed by the terms *uni-*, *bi-*, *tri-*, *quadri-*, and so on to *multi-locular*. Such pistils have *axile* placentæ—*i.e.*, they are gathered about the axis of the ovary, *e.g.*, *Hypericum*. In the case of compound pistils formed by the coalescence of open carpels, the margins only of the

latter unite, forming a common ovary cavity; here the placentæ generally occur along the sutures, and are said to be *parietal*—i.e., on the walls. Between such unilocular pistils and the multilocular ones described above there are all intermediate gradations. In one series of gradations the placentæ project farther and farther into the ovary cavity, at last meeting in the centre, when the pistil becomes multilocular with axile placentæ. On the other hand, a multilocular pistil sometimes becomes unilocular by the breaking away of the partitions during growth. In such a case the placentæ form a free central column, commonly called a *free central placenta*.

In other cases a free placental column of an entirely different origin occupies the axis of a unilocular, but evidently polycarpellary pistil. In *Anagallis*, for example, the placental column grows from the base of the ovary cavity, and there is at no time a trace of partitions (see illustrations of the Order Primulaceæ, p. 507).

The Gynœcium may be free from all the other organs of the flower, which are then said to be *hypogynous*,\* and the gynœcium itself *superior*. Sometimes the growth of the broad flower-axis stops at its apex long before it does so in its marginal portions; a tubular ring is thus formed, carrying up calyx, corolla, and stamens, which are then said to be *perigynous*,† and the gynœcium *half inferior*. These terms are used also in the cases where the gynœcium is similarly surrounded by the tubular sheath composed of adnate calyx, corolla, and andrœcium. In some nearly related cases, in addition to the structures described above as perigynous, there is a complete fusion of the calyx, corolla, and stamen-bearing tube with the gynœcium, so that the ovule-bearing portion of the latter is below the rest of the flower, e.g., Compositæ. The perianth and the stamens are said to be *epigynous*‡ in such flowers, and the ovary is *inferior*. Some cases of epigyny are doubtless to be regarded as due to the adnation of the calyx, corolla, stamens, and ovaries; in others, the ovaries are adnate to the hollow axis which bears the perianth and stamens; in still others, it seems probable that the hollow axis is itself ovule-bearing, and that the true carpels are borne on its summit.

Certain terms descriptive of relations between the stamens and pistils which have recently come into use require explanation here.

In many flowers the stamens and pistils do not mature at the same time, such are said to be *dichogamous*; when the stamens mature before the pistils the flower is *proterandrous*; and when the pistils mature before the stamens they are *proterogynous*.

In some species of plants there are two or three kinds of flowers,

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\* From Greek *ὑπό*, under, and *γυνή*, female—i.e., the pistil.

† From the Greek *περί*, about, etc.

‡ From the Greek *ἐπί*, upon, etc.

differing as to the relative lengths of the stamens and styles ; these are called *heterogonous\** or *heterostyled*. When there are two forms, viz., one in which the stamens are long and the styles short, and the other with short stamens and long styles, the flowers are said to be *dimorphous*, or more accurately *heterogonous dimorphous*, and the forms are distinguished as *short-styled* and *long-styled*. When, as in some species of *Oxalis*, there are three forms, viz., long-, mid-, and short-styled, the term *trimorphous* (or better *heterogonous trimorphous*) is used.

**The Fruit.**—The fruit may include (1) only the ripened ovary with its contained seeds—*e.g.*, the bean ; or (2) these with an adnate calyx or receptacle—*e.g.*, the apple. Many changes frequently take place in ripening, such as (1) an increase in the number of cells by the formation of false partitions, or (2) a decrease in their number by the obliteration of some ; (3) the growth of wings or prickles upon the exterior of the ovary ; (4) the thickening and formation of a soft and juicy pulp ; (5) the hardening of some portions of the ovary wall by the development of sclerenchyma ; (6) the thickening and growth of the calyx or receptacle.

In cases where in the ripening the ovary walls remain thin, and eventually become dry, the fruits are said to be *dry*—*e.g.*, in the bean ; where the walls become thickened and more or less pulpy, they are *fleshy*—*e.g.*, the peach. These terms are also used in reference to the fruit when it includes an adnate calyx or receptacle. In many fleshy fruits (developed from carpels) the inner part of the pericarp wall is hardened ; the two layers are then distinguished as *exocarp* and *endocarp* ; when there are three layers the middle one is the *mesocarp*.

The opening of the fruit in order to permit the escape of the seeds is called its *dehiscence*, and such fruits are said to be *dehiscent* ; those which do not open are *indehiscent*. In fruits developed from single carpels dehiscence is generally through the ventral or dorsal suture, or both ; in those developed from compound pistils the partitions may split, and thus resolve each fruit into its original carpels (*septicidal dehiscence*) ; or the dorsal sutures may become vertically ruptured, thus opening every cell (loculus) by a vertical slit (*loculicidal dehiscence*). Among the other forms of dehiscence only that called *circumscissile* and the *irregular* need be mentioned ; in the former a transverse slit separates a lid or cap, exposing the seeds ; in the latter an irregular slit forms at a certain place, and through this the seeds escape.

The principal fruits may be distinguished by the brief characters given in the following table :†

\* Proposed by Dr. Gray, *Am. Naturalist*, Jan., 1877.

† This is based upon Dr. Dickson's classification as modified by Professor Balfour in the article "Botany" in the ninth edition of the "Encyclopædia Britannica," Vol. IV., p. 153.

- A. Monogynæcial fruits**, formed by the gynoecium of one flower.
- I. Capsulary fruits.** Dry, dehiscent, formed from one pistil.
1. Monocarpellary.
    - (a) Opening by one suture—*e.g.*, *Caltha*.....FOLLICLE.
    - (b) Opening by both sutures—*e.g.*, *Pea*.....LEGUME.
  2. Bi-polycarpellary—*e.g.*, *Viola*.....CAPSULE.
    - Var. *a.* Dehiscence circumcissile—*e.g.*, *Anagallis*.....PYXIS.
    - Var. *b.* Dehiscence by the falling away of two lateral valves from the two persistent parietal placentæ—*e.g.*, *Mustard*.....SILIQUA.
- II. Schizocarpic fruits.** Dry, breaking up into one-celled indehiscent portions.
1. Monocarpellary, dividing transversely—*e.g.*, *Desmodium*.....LOMENY.
  2. Bi-polycarpellary.
    - (a) Dividing into achene-like or nut-like parts (nutlets), no forked carpophore—*e.g.*, *Lithospermum*.....CARCERULUS.
    - (b) Dividing into two achene-like parts (mericarps), a forked carpophore between them—*e.g.*, *Umbellifera*.....CREMOCARP.
- III. Achenial fruits.** Dry, indehiscent, one-celled, one or few seeded, not breaking up.
1. Pericarp hard and thick—*e.g.*, *Oak*.....NUT.
  2. Pericarp thin—*e.g.*, *Sunflower*.....ACHENE.
    - Var. *a.* Pericarp loose and bladder-like—*e.g.*, *Chenopodium*.....UTRICLE.
    - Var. *b.* Pericarp consolidated with the seed—*e.g.*, *Grasses*.....CARYOPALS.
    - Var. *c.* Pericarp prolonged into a wing—*e.g.*, *Ash*.....SAMARA.
- IV. Baccate fruits.** Fleshy, indehiscent; seeds in pulp.
1. Rind firm and hard—*e.g.*, *Pumpkin*.....PEPO.
  2. Rind thin—*e.g.*, *Gooseberry*.....BERRY.
- V. Drupaceous fruits.** Fleshy, indehiscent; endocarp indurated, usually stony.
1. One stone, usually one-celled—*e.g.*, *Cherry*.....DRUPE.
  2. Stones or papery carpels, two or more—*e.g.*, *Apple*.....POME.
- VI. Aggregate fruits.** Polycarpellary; carpels always distinct. The forms of these are not well distinguished. In many *Ranuncu-*

laceæ there are numerous achenes on a prolonged receptacle; in *Magnolia* numerous follicles are similarly arranged; in the raspberry many drupelets cohere slightly into a loose mass, which separates at maturity from the dry receptacle; in the blackberry similar drupelets remain closely attached to the fleshy receptacle; in the strawberry there are many small achenes on the surface of the fleshy receptacle; finally, in the rose several to many achenes are enclosed within the hollow and somewhat fleshy receptacle.

*B. Polygynæcial fruits, formed by the gynœcia of several flowers.*

1. A spike with fleshy bracts and perianths—*e.g.*,  
*Mulberry*.....SOROSIS.
2. A spike with dry bracts and perianths—*e.g.*,  
*Birch*.....STROBILE.
3. A concave or hollow, fleshy receptacle, enclosing  
many dry gynœcia—*e.g.*, *Fig*.....SYCONUS.

**The Seed.**—Many of the terms used in the description of the ovule are applied also to the seed. However, the modifications which most of the parts undergo render necessary some additional terms. Thus the outer integument is generally so thickened and hardened that it is commonly called the *testa*. The inner is sometimes called the *tegmen*. In some seeds the outer coat becomes fleshy, in which case they are baccate (berry-like); in others the outer part of the testa is fleshy and the inner hardened, so that the seed is drupe-like (drupaceous). Occasionally an additional coat forms around the ovule after fertilization; it differs somewhat in nature in different plants, but all are commonly included under the name *aril*—*e.g.*, May Apple.

The testa may be prolonged into one or more flat extensions; such a seed is *winged*—*e.g.*, *Catalpa*. Its epidermal cells may be prolonged into trichomes, forming the *comose* seed—*e.g.*, cotton.

The embryo either occupies the whole of the seed cavity, in *exalbuminous* seeds, or it lies in or in contact with the endosperm, in the *albuminous* seeds. It is *straight*—*e.g.*, the pumpkin; or variously curved and folded—*e.g.*, in *Erysimum*, where the cotyledons are *in-cumbent*, and in *Arabis*, where they are *accumbent*.

**537.—The Tissues of Angiosperms.**—The epidermis of Angiosperms does not differ in any marked way from that of the Gymnosperms and the Pteridophytes. The principal differences are that, as a rule, the stomata are more numerous, and the trichomes, which are much more commonly present, show greater variations in form and structure. It is noticeable, furthermore, that in both these points the Dicotyledons excel the Monocotyledons.

**538.**—The tissues of the fundamental system in the Angiosperms are, in general, sharply set off from those of the epidermal and fibro-vascular systems. In the annual stemmed species the fundamental tissues constitute the greater part of the stems, but in perennial-stemmed species there is proportionately less of these, and more of the fibro-vascular tissues; in the former the principal tissue in the fundamental system is parenchyma, which occupies the interfascicular spaces, as well as the greater part of that lying between the bundles and the epidermis—*i.e.*, in the cortical region. In perennials, on the contrary, the interfascicular spaces are in many cases occupied by sclerenchyma, and the cortical region either entirely disappears (as in Dicotyledons) or it becomes filled with sclerenchymatous or fibrous tissue.

In the leaves the fundamental system rarely includes more than chlorophyll-bearing parenchyma, while in the parts of flowers a similar tissue is found, which is, however, generally wanting in chlorophyll. The succulent parts of fruits, whether phyllome or caulome structures, are composed of parenchyma of the fundamental system.

**539.**—The fibro-vascular bundles of the stems of Angiosperms are entirely of De Bary's "collateral" class—that is, each bundle in cross-section presents more or less distinctly two sides, *viz.*, xylem and phloëm. Each of these sides, as previously described (paragraph 147), generally contains parenchymatous, fibrous, and vascular tissues, the latter tracheary in the xylem, and sieve in the phloëm.

**540.**—The disposition of the bundles in the Angiosperms is for the most part dependent upon the position of the leaves. Nearly all the first-formed bundles are of the kind termed "common bundles"—that is, they extend on the one hand into the leaf, and on the other down into the stem. In Fig. 314 there pass down from each leaf three bundles; at the lower internode these are, on the left, *a, b, c*, and on the right, *d, e, f*. At the next internode, where the leaves stand at right angles to the lower ones, there are three bundles again, *g, h, i*, and *k, l, m*; these are largest at their points of curvature, and they dwindle in size as they pass downward and finally unite with the bundles from the lower

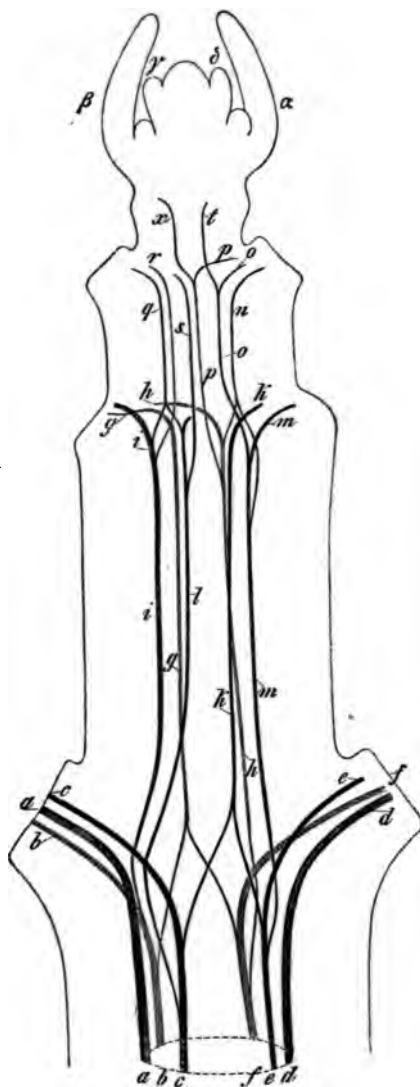


Fig. 314.—Showing the disposition of the fibro-vascular bundles in the stem of *Clematis vitalba*. *a, b, c, — d, e, f,* the bundles from the lower pair of leaves; *g, h, i, — k, l, m,* the bundles from the second pair of leaves; *n, o, p, — q, r, s,* the bundles from the third pair of leaves; *x* and *t*, the median bundles of leaves; *alpha, beta, — gamma, delta,* pairs of rudimentary leaves not yet supplied. After Nageli.



pair of leaves. The bundles from the third internode pass downward, and in like manner join those from the second pair of leaves, and so on. Thus in such a stem every bundle

passes downward through one internode before joining another, and in any internode all the bundles are derived from the leaves at its summit.

In Fig. 315, with a similar arrangement in the main, there are some complications. The lateral leaf-bundles (*b, c* in the lower internode, and *g, h* in the next one) pass downward to the next node, where they unite with other descending bundles; and the median bundles, *a, f, l, o, r, u*, pass down through two internodes, and then fork right and left, and unite with other descending bundles. Thus in

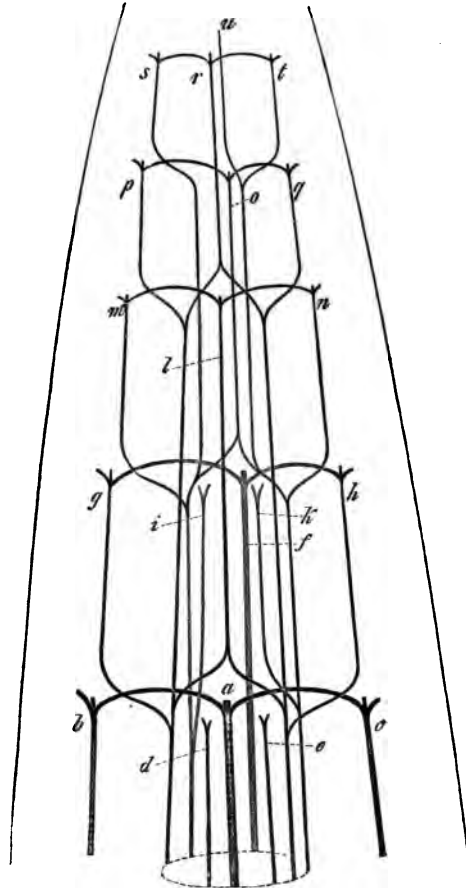


Fig. 315.—Diagram showing the arrangement of the fibro-vascular bundles in the stem of *Lathyrus Pseudophaea*. The bundles nearest the observer are figured darker, those farthest away lighter.—After Nägeli.

any internode there are bundles from at least three leaves. This is shown in the cross-section of the next to the lower internode (Fig. 316), in which the bundles *h, f, g, k, i* pass

into the second leaf—i.e., the leaf at the summit of the internode under consideration; the bundles *l*, *m*, *n* descend from the leaf next above, and *p* and *q* from the one still higher.

541.—We may get a clearer idea of the mutual relations of the bundles if we conceive the bundle-cylinder to be split down on one side, and spread out upon a plane. In Fig. 317 we have such a diagrammatic representation of the arrangement of the bundles in the stem of *Stachys angustifolius*. Here each leaf sends down two bundles, which pass through two internodes and then unite

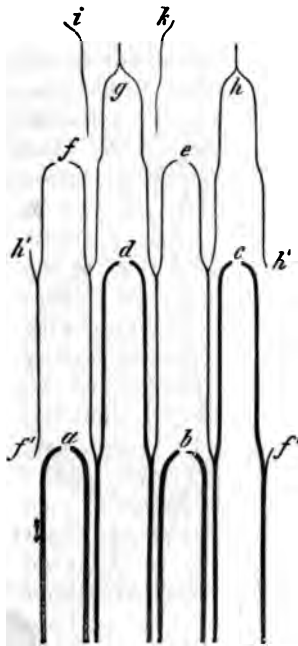


Fig. 317.—Diagram showing the arrangement of the fibro-vascular bundles in *Stachys angustifolius*. *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *k*, the points from which the successive pairs of leaves spring.—After Nägeli.

projected upon a series of transverse and vertical li

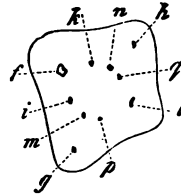


Fig. 316.—Cross-section of the next to the lower internode of Fig. 315, showing the arrangement of the bundles, the lettering as in Fig. 315.—After Nägeli.

with other descending bundles at their middle points. The fibro-vascular cylinder is thus composed when complete of repeatedly branching bundles. A cross-section (Fig. 318) through the stem at some distance above the lower leaves in Fig. 317 shows that each internode contains bundles from two pairs of leaves—i.e., those at its summit and those at the summit of the one above. In Fig. 318 the pairs of bundles marked *c* and *d* descend from the leaves *c* and *d*, while those marked *e* and *f* pass down from the leaves one internode higher up.

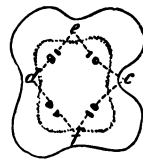


Fig. 318.—Cross-section of the next to the lower internode in Fig. 317, showing the disposition of the bundles, the lettering as in Fig. 317.—After Nägeli.

In a similarly constructed diagram of the fibro-vascular

der of *Iberis amara* (Fig

indicate the nodes and the vertical ranks of leaves) the single bundles which descend from the leaves are shown to pass through from ten to twelve internodes before uniting with

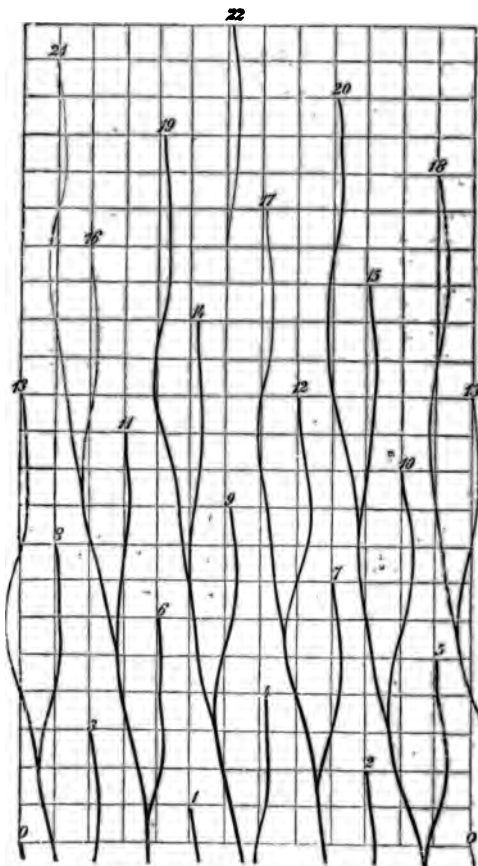


Fig. 319.—Diagram showing the arrangement of the fibro-vascular bundles in internodes of the stem of *Ibertis amara*.—After Nägeli.

other bundles. It is seen, moreover, that there are running through the stem five series of branching bundles, which are not quite vertical, but slightly spiral. In Fig. 320 is shown the appearance of an actual section of the stem taken b

tween the fifth and sixth leaves of the preceding figure. The bundles are numbered as in Fig. 319.

**542.**—In a comparatively small number of instances there are fibro-vascular bundles in the stem which have no connection with the leaves. These are known as cauline bundles.

**543.**—In the Monocotyledons and many herbaceous Dicotyledons, the fibro-vascular bundles are closed—that is, there is no zone of meristem tissue left between the xylem and phloëm after these have passed over into permanent tissues. There is, as a consequence, a definite period of growth for the bundles, and when any bundle has fully formed all its tissues, no further development can take place in it. This generally results in definitely limiting the growth of the internodes, and in consequence such plants are as a rule short-lived. The perennial woody-stemmed Dicotyledons, and some of the herbaceous annuals, possess bundles which are open—that is, there is left between the xylem and the phloëm a zone of meristem tissue which continues to grow long after the other parts of the bundle have passed over into permanent tissues. Plants with such bundles may live and continue to grow for an indefinite time.

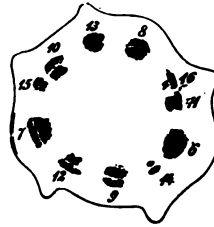


Fig. 320.—Cross-section of the stem of which Fig. 319 is the diagram, taken above the fifth leaf.—After Nagell.

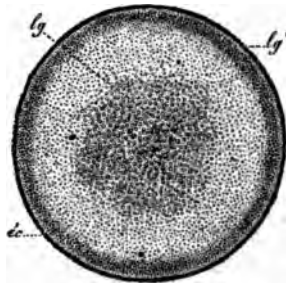


Fig. 321.—Cross-section of the stem of a palm. *cc*, cortical zone; *lg*, the softer interior portion of the stem; *lg'*, the harder peripheral portion.—After Duchartre.

**544.**—A cross-section of the stem of a Palm (Fig. 321) shows it to be composed of parenchymatous tissue traversed by myriads of fibro-vascular bundles, which descend from the crown of leaves. Each leaf sends down from its broad insertion numerous bundles, which, in a vertical section, are seen first to pass in toward the centre of the stem, and then to curve downward and finally outward. The centre of the stem is thus softer than the peripheral portion, as in the latter the descending

bundles are more numerous. In such a stem it is evident that there can be no considerable increase in thickness after it is once formed, and we consequently find that palms take a long time for the formation of a broad bud or growing point (*punctum vegetationis*), and afterward push up a cylindrical stem in which little change subsequently takes place.

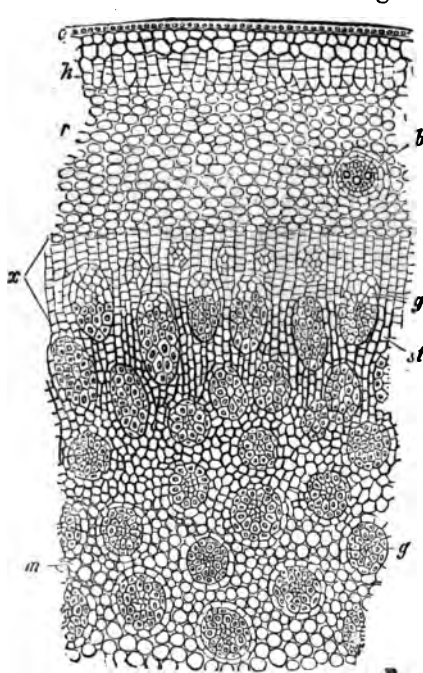


Fig. 322.—Cross-section of stem of *Dracæna*. *e*, epidermis; *k*, cork; *r*, cortex; *b*, a fibro-vascular bundle bending out to a leaf; *m*, parenchyma of the fundamental system; *g*, *g*, fibro-vascular bundles; *x*, meristem zone of the fundamental system in which new bundles and tissues are forming.—After Sachs.

which connects the cambium layer of one fibro-vascular bundle with that of the other (Fig. 323). This is made easier from the fact that in most (but not all) Dicotyledons the bundles lie at nearly the same depth beneath the epidermis on all sides of the stem, thus forming a cylinder, or in cross-section, a ring, as in Fig. 323. Both the fascicu-

In the Dragon trees (*Dracæna*, sp.) and some other Monocotyledons, there is a thick layer of parenchymatous cortex between the column of fibro-vascular bundles and the epidermis (Fig. 322, *r*), and in the deeper layers of this a persistent meristem tissue is found (Fig. 322, *x*). In this meristem there are formed fibro-vascular bundles, which lie parallel to those already formed, and in this way the stem slowly increases in thickness.

545.—In those Dicotyledons whose stems increase in thickness there always develops soon a layer of meristem tissue,

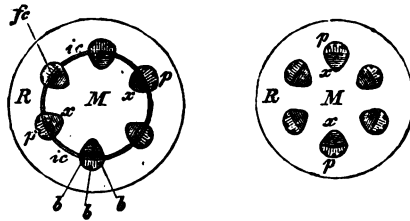


Fig. 323.—Diagrams of dicotyledonous stems as seen in cross-section. *R*, the cortical, *M*, the medullary portion of the fundamental system; *p*, the phloem; *x*, the xylem; *b*, *b*, *b*, groups of bast fibres; *fc*, the fascicular, *ic*, the interfascicular cambium.—After Sachs.

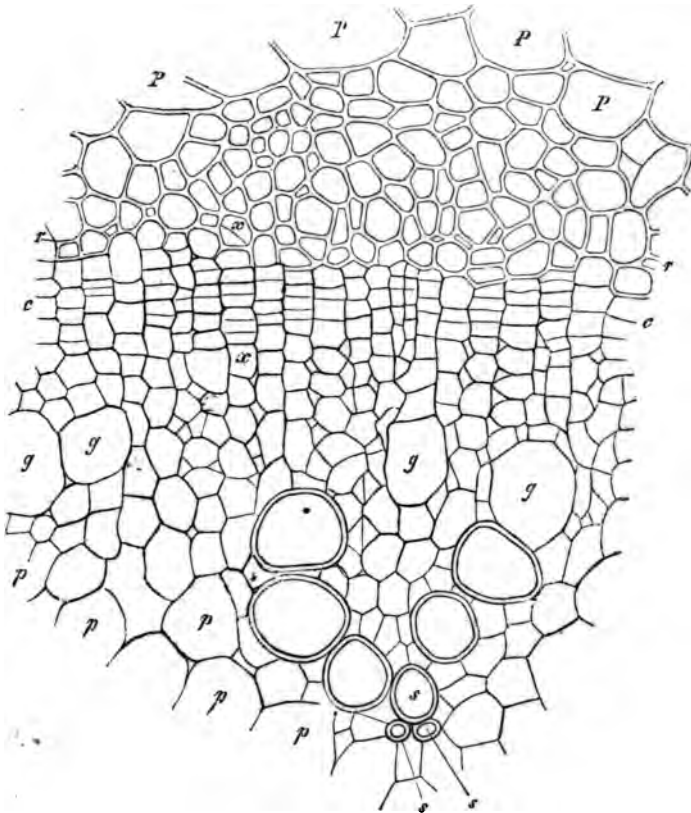


Fig. 334.—Cross-section through a young internode of *Sambucus nigra*. *P*, *P*, cortical parenchyma; *p*, *p*, parenchyma of the pith; between *r-r* and *P-P*, sieve tissue; *g*, *g*, pitted vessels; *s*, *s*, and above, spiral vessels; *c-c*, the cambium zone.  $\times$  230.—After De Bary.

lar and interfascicular cambium layers are composed of elongated cells, which multiply by fission in a tangential direction, and thus give rise to radiating rows of cells (Figs. 324 and 325). In a tangential section the cambium cells present an elongated outline, and their extremities are usually more or less oblique (Fig. 326). From these cells there develop various tissues. Thus, on the one side, the phloëm parenchyma, sieve and fibrous tissues may be produced by more or less great modifications (Fig. 327). On

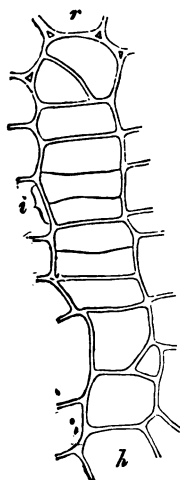


Fig. 325.—The row of cells marked  $\omega$ — $\omega$  in Fig. 324;  $r$ , phloëm;  $h$ , xylem;  $at$  are seen the fissions of the cambium cells.  $\times 600$ .—After De Bary.

the other side (the xylem side) new vessels, fibres, and parenchyma are also developed (Fig. 328). The development of these tissues begins in the inner and outer layers of the cambium, and advances toward the central layers. It never happens, however, that all the cambium layers pass over into permanent tissues, there always remaining one or a few meristem layers.

546.—A study of Figs. 326–328 will show the probable mode of development of the permanent tissues from the meristem tissue of the cambium. It is evident from a comparison of Figs. 326 and 327 that the phloëm parenchyma is produced by the formation of several transverse partitions in each cambium cell, and it is probable that in many cases there is a direct conversion of cambium cells into sieve tubes. That the cambium cells may be converted directly into tracheïdes is evident from Fig. 326, and also Fig. 75 (p. 84). In Fig. 328 it is plain that the fibrous tissue ( $lf$ ) and tracheïdes ( $t$ ) have the same origin, and the indications are that even the large pitted vessels ( $gg$ ) are formed from cambium cells by the great increase in the diameter of the latter, the thickening of their vertical walls, and the partial or complete absorption of their transverse walls. The origin of the xylem parenchyma from cam-

bium cells by the formation of transverse partitions is very clear in this figure.

547.—In the trees and shrubs of cold climates, or of those in which there is one annual period of growth, followed by a period of rest or the cessation of growth, the

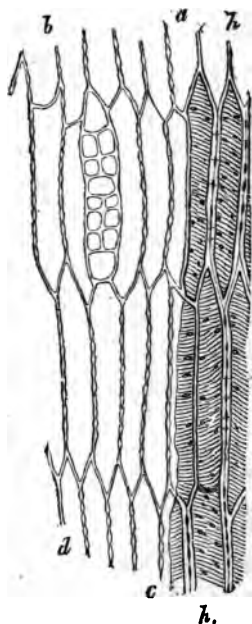


FIG. 326.

Fig. 326. A tangential section of the cambium region of *Cytisus Laburnum*. *a, b, c, d*, cambium cells enclosing the section of a medullary ray; *h, h,* tracheides belonging to the xylem.  $\times 145$ .—After De Bary.

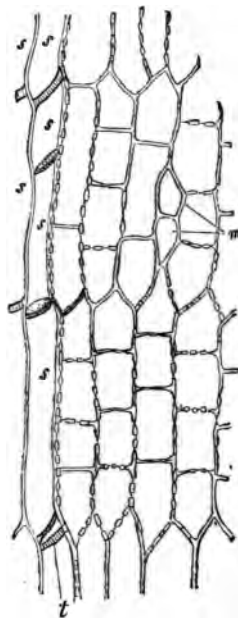


FIG. 327.

Fig. 327.—Tangential section of the inner phloem region of the same stem as Fig. 326. *s, s, s,* sieve vessels; *m,* section of a small medullary ray; the remaining parts of the figure are phloem parenchyma.  $\times 145$ .—After De Bary.

processes described above take place each year, giving rise thus to an annual layer of xylem (wood) outside of the previously formed xylem cylinder, and an annual layer of phloem (bark) inside of the phloem cylinder. In the wood these layers are generally quite well marked, and in cold climates they enable us to determine with accuracy the age



of trees and shrubs (Fig. 329): The layers of the bark are rarely well marked, and they generally become soon obliterated by irregular corky growths in the substance of the bark

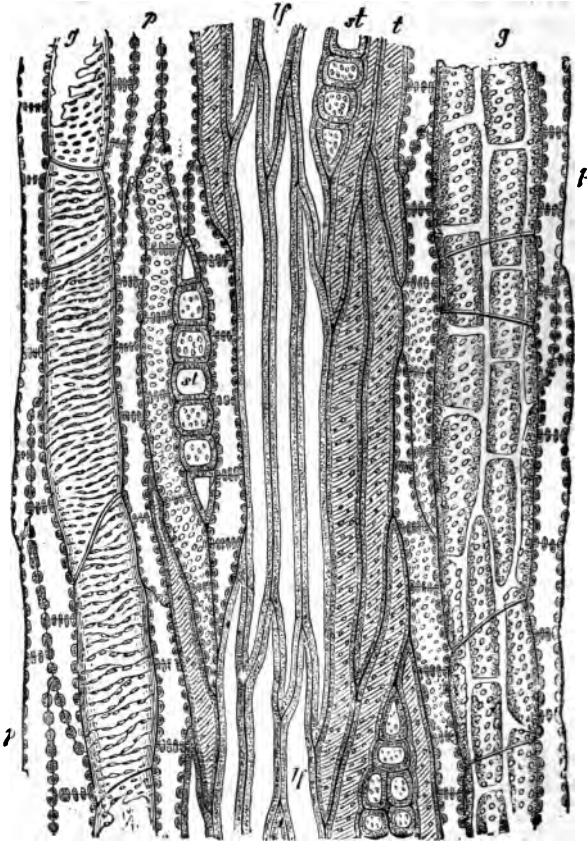


Fig. 329.—Tangential section of the stem of *Ailanthus glandulosa*, through the secondary xylem: *g, g*, pitted vessels; *p, p*, xylem parenchyma; *st, st*, medullary rays in cross-section; *lf*, fibrous tissue (wood cells); *t, t*, tracheides. Highly magnified.—After Sachs.

itself. They are, moreover, ruptured by the increase in the diameter of the woody cylinder, and soon decay and fall away. It thus happens that while the annual layers of the wood are constantly increasing in number, reaching in ex-

treme cases more than a thousand,\* the bark rarely shows more than a few distinct layers, and its thickness is generally very much less than that of the former.

From what has been said it is seen that a dicotyledonous stem several years old is composed of a series of larger and larger continuous woody shells (Fig. 330, 1, 2, 3, 4, 5) surrounded by a corresponding series of bark shells, which are smaller and smaller (Fig. 330, 5', 4', 3', 2', 1').

**548.—The Medullary Rays.** In the young dicotyledonous stems there are thick masses of parenchyma, which connect the cortical with the medullary (pith) portion of the fundamental system of tissues (Fig. 323). However, as the fibro-vascular bundles increase, these masses become thinner, until they are mere plates, often not more than one or two, or at most a few cells in thickness (Figs. 326-7-8). From their appearance and position they have long borne the name of Medullary Rays. In the young stem their cells may be parenchymatous, but in older ones they are frequently sclerenchymatous. Viewed in a radial

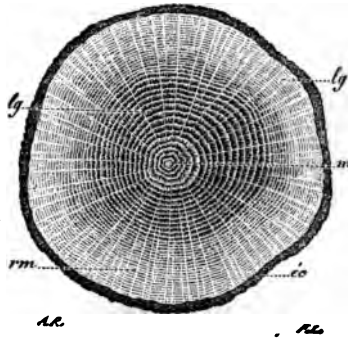


Fig. 329.—Cross-section of the stem of an oak (*Quercus Robur*) thirty-seven years old. *m*, pith; *lg*, heart-wood; *lg'*, sap-wood; *rm*, medullary rays; *ec*, the bark. Much reduced. —After Duchartre.

section of the stem, they are generally seen to be elongated in the direction of the radius, having the outlines of right-angled quadrilaterals. In the increase of the diameter of the stem there is always an increase in the length of the medullary rays, both in their bark and wood portions; and when from their divergence a considerable space intervenes between two rays, one or more new ones arise between them; thus while there may be no more than four or five rays in the young plant, it may when old have hundreds of them in its circumference (Fig. 329).

What has been said of the tissues of the Angiosperms must suffice to

\* In the Lime (*Tilia Europæa*) 1076 and 1147, and in the Oak (*Quercus Robur*) 1080 and 1500, according to De Candolle.

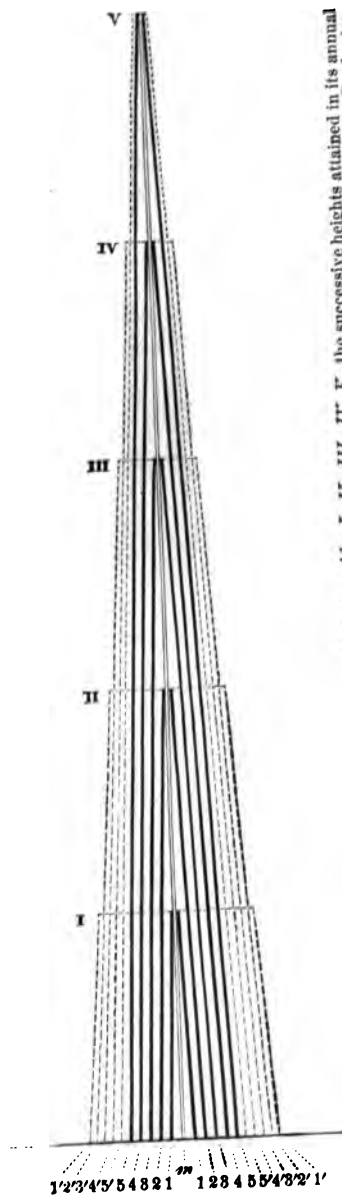


Fig. 330.—An ideal vertical section of a dicotyledonous stem, five years old. I., II., III., IV., V., the successive heights attained in its annual growth; *m*, pith; 1, 2, 3, 4, 5, the annual xylem layers corresponding respectively to the annual phloem layers, 1', 2', 3', 4', 5'.—After Duchartre.

introduce the student to their study. For further details, he is referred to De Bary's admirable treatise, "*Vergleichende Anatomie der Vegetationsorgane der Phanerogamen und Farne*," in which copious references are given. The publications of Russow will also be found to be of great value to the student.

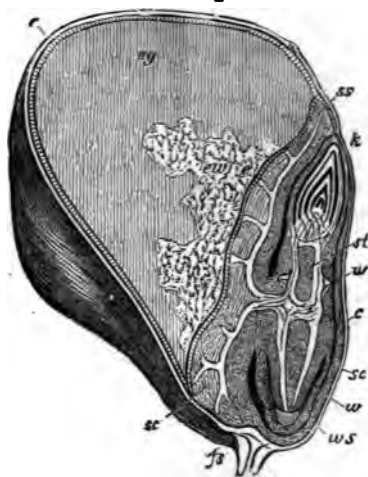
**549.**—The systematic arrangement of the Angiosperms is by no means settled. The one mostly followed in England and this country is a modification of De Candolle's system (A.D. 1813), which was itself a modification of Jussieu's (A.D. 1789), which in turn was based upon the general system proposed by Ray (A.D. 1703). In the "*Genera Plantarum*," now publishing by Bentham and Hooker, and in the English edition of Le Maout and Decaisne's "*General System of Botany*," we have the most recent modifications of the Candollean system. On the continent of Europe other systems have been used more or less, and it is probable that among these are to be found the best groupings of Angiosperms to indi-

cate their real affinities. Unfortunately for us, however, none of our systematic manuals follow any of the Continental systems; we are compelled, therefore, to use for the present the prevailing form of the Candollean system. In this book the sequence of the groups is the reverse of that in most American and English books, in order to bring the arrangement of Angiosperms into harmony with that of the rest of the vegetable kingdom.

## SUB-CLASS I. MONOCOTYLEDONES.

(Endogenæ of De Candolle.\*)

550.—In these plants the first leaves of the embryo are



alternate, hence we say that they have one cotyledon. The venation of the leaves is for the most part such that the veins run more or less parallel to one another, and when they anastomose enclose four-sided areolæ; rarely, however, their veins are irregularly distributed, and they anastomose so as to form an irregular network.

Fig. 331.—Longitudinal section of the seed of Indian corn (*Zea Mays*). *c*, adherent wall of the ovary; *n*, remains of the style; *fs*, base of the ovary; all the remainder of the figure is the true seed; *eg*, *ew*, endosperm; *sc*—*ss*, cotyledon of embryo; *c*, its epidermis; *k*, plumule; *w* (below), the main root; *ws*, the root-sheath; *w* (above), adventitious roots springing from the first internode of the stem.  $\times 6$ .—After Sachs.

has its broad dorsal surface in contact with the endosperm; anteriorly

The germination of Monocotyledons may be illustrated by a couple of examples. In the seed of the Indian corn the embryo lies partly imbedded in one side of the large endosperm (Fig. 331). The first leaf of the young plant (the cotyledon or scutellum, Fig. 331, *sc*,

\* From the Greek ἐνδον, within, and γέρειν, to bring forth. The name was given under the false impression that these plants were "inside growers," and the Dicotyledons "outside growers."

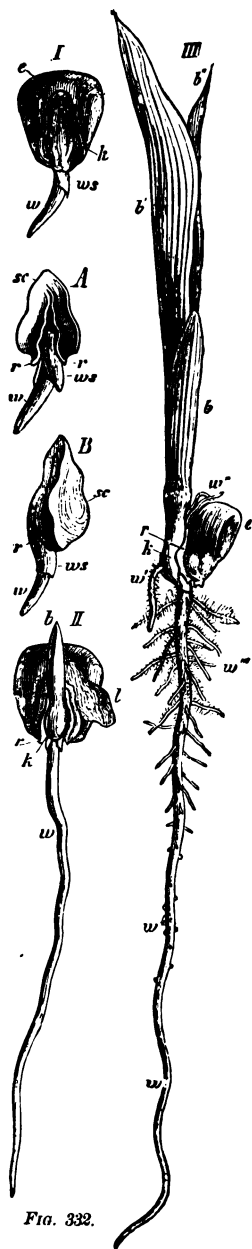


FIG. 332.

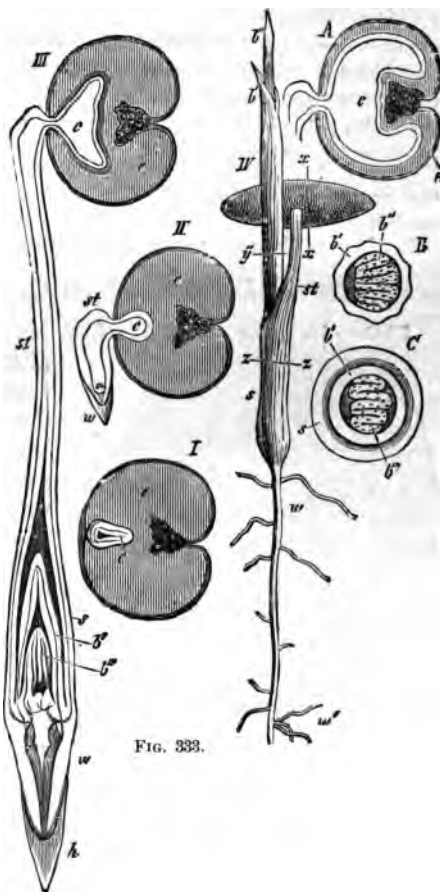


FIG. 333.

Fig. 332.—Germination of Indian corn. *I*, *II*, *III*, successive stages. *A* and *B*, front and side views of a separated embryo. In the figures, *w*, the primary root; *ws*, its root-sheath; *w'*, *w''*, adventitious roots; *w'''*, lateral roots springing from the main root; *e*, part of seed filled with endosperm; *sc*, cotyledon; *r*, its open margins; *k*, the plumule; *b*, *b'*, *b''*, leaves of young plant; *l*, fragment of wall of ovary. Natural size.—After Sachs.

Fig. 333.—Germination of the Date (*Phoenix dactylifera*). *I*, transverse section of seed; *e*, embryo; *k*, endosperm. *II*, *III*, sections of germinating seeds; *c*, apex of cotyledon developing into an absorbing organ; *st*, stalk of cotyledon; *s*, sheath of cotyledon; *b'*, *b''*, leaves; *w*, root; *w'*, lateral roots; *h*, root-cap. *IV*, young plant, natural size. The lettering as in *III*. *A*, section of *IV*. at *x*—*y*; *B*, section at *x*—*y*, the lettering as in *III*. *C*, section at *s*—*s*, the lettering as in *III*.—After Sachs.

it is curved entirely around the remainder of the embryo. Under proper conditions the main root pushes through the root sheath (*ws*, Figs. 331, 332). The plumule, consisting of a minute stem and a few rudimentary leaves, next pushes out through the upper end of the curved cotyledon (*II*, Fig. 332). The cotyledon remains in contact with the endosperm and absorbs nourishment from it for the sustenance of the growing parts. Lateral roots soon appear upon the main root, and adventitious ones arise from the first internodes of the stem (*w'''*, *w''*, *w'*, Fig. 332). The first leaf above the cotyledon is quite small (*b*), and each succeeding one becomes larger and larger until the full size is reached.

In the Date the small embryo lies imbedded transversely in the large endosperm. In germination the cotyledon elongates and carries the enclosed root and plumule outside of the seed (*II* and *III*, Fig. 333). The apex of the cotyledon (*c*) expands into an organ through which the dissolving endosperm is absorbed. The root pushes downward, and soon develops lateral roots (*w*). The plumule grows upward, escaping from the enclosing cotyledon, as shown in *IV*, Fig. 333. The first leaves above the cotyledon are here, as in the Indian corn, much less perfectly developed than the later ones.

**551.**—The sub-class Monocotyledones contains about fifty natural orders of plants, which are grouped into fifteen cohorts. Of these only a few need be noticed.

**552.—Cohort I. Glumales.** Grass-like plants with the flowers in the axils of scales, which are arranged in spikelets; the stamens are from one to three, rarely more; the single ovary contains but one ovule, and these at maturity are completely coalesced, forming a caryopsis.

**Order Gramineæ.—The Grass Family.** Herbaceous or rarely woody plants, with round, jointed, and mostly hollow stems, bearing alternate two-ranked leaves with split sheaths. (Figs. 334-9.)

This very natural order contains about 4500 species, which are distributed in all climates. In the tropics they are mostly almost tree-like (Bamboo); in the temperate climates they are mostly annuals with a close mat, while in the colder countries they are mostly perennials. Very many of the species are valuable on account of their nutritious herbage. None are poisonous (except a few exceptions).

*Triticum vulgare*, Wheat, a native product of the East, has been under cultivation in temperate climates for many years. Remains of wheat grains have been found in lake dwellings in Switzerland, proving that it was in prehistoric times. In the United States it has been cultivated for many years.

some of these are hardy (winter wheats), others are tender (spring wheats); some are awned, others awnless; in some the grains are

FIGS. 334-9.—INFLORESCENCE OF THE OAT.

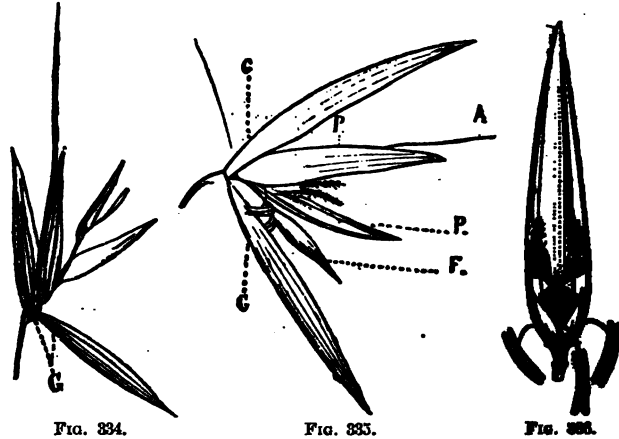


FIG. 334.

FIG. 335.

FIG. 336.

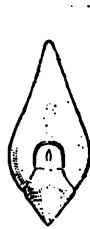


FIG. 337.

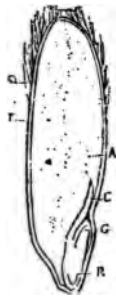


FIG. 338.

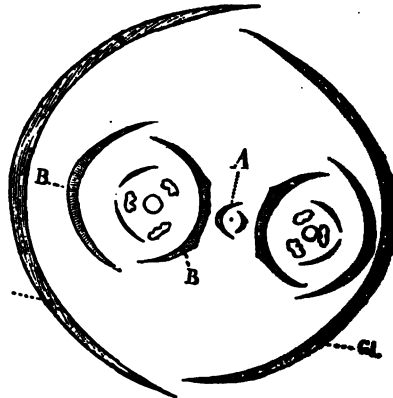


FIG. 339.

Fig. 334.—Spikelet.

Fig. 335.—Spikelet opened. *G*, glumes; *P*, paleas; *A*, awn; *F*, abortive flower.

Fig. 336.—Flower with upper palea.

Fig. 337.—Embryo.

Fig. 338.—Section of grain.

Fig. 339.—Diagram of spikelet. *Gl*, glumes; *D*, paleas; *A*, abortive flower.

dark in color (red wheats), in others they are light colored (white wheats). Fabre's experiments about a quarter of a century ago appear to indicate that wheat was originally derived from a wild grass called

*Ægilops ovata*. From it, in the course of from ten to twelve years, he succeeded in producing the form known as cultivated wheat. (See *Gardener's Chronicle*, July, 1852.)

*Secale cereale*, Rye, is probably a native of Southeastern Europe and Southwestern Asia. It has been cultivated for ages and is still much grown in temperate climates.

*Hordeum vulgare*, Barley. A native probably of the same region as Rye; has also been long under cultivation. One or two other species are also grown.

*Avena sativa*, the Oat, was formerly much used as food for man, especially in cool climates, where it succeeds best. It is now less used. Its native country is not certainly known, but it was probably northern Europe or Asia.

*Oryza sativa*, Rice, has been long under culture in Southeastern Asia, of which country it was probably a native. It is now cultivated also in Egypt, Italy, Brazil, and the Southern United States. It furnishes food to more human beings than any other single plant.

*Zea Mais*, Maize or Indian Corn, a native of the warmer parts of the New World, was cultivated by the aborigines of both North and South America before the advent of Europeans. It is one of the most valuable of the cereals, and is now cultivated almost all over the world. Of its numberless varieties the larger are grown in the hotter, and the smaller in the cooler climates.

The more important forage grasses are the following:

*Phleum pratense*, Timothy or Herd's Grass, a native of Europe is valuable on rich soils.

*Agrostis vulgaris*, Red-top, a native of Europe, grows well on moist soils.

*Dactylis glomerata*, Orchard Grass, a native of Europe, is valuable because of its growing well in the shade, and so furnishing hay and pasture in orchards and woodlands.

*Poa pratensis*, Kentucky Blue Grass, a native of the Eastern United States and of Europe, is in the latitude of Kentucky the best of all our pasture grasses. In drier regions it is small and harsh.

*Muhlenbergia glomerata* and *M. Mexicana* constitute the "Fine Slough Grass" of the Mississippi valley prairies. They furnish valuable hay.

Several species furnish sugar:

*Saccharum officinarum*, Sugar Cane, a native of the warmer parts of Asia, is a large plant somewhat resembling Indian corn in size and appearance. From its sweet juice most of the sugar and molasses of com-

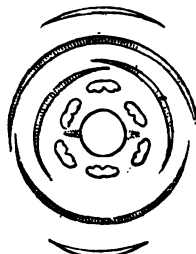


Fig. 340.—Diagram of hexandrous flower of Rice.



merce are made. It is cultivated extensively in the Southern United States, Cuba, Brazil, and, in fact, in all warm countries of the world.

FIGS. 341-4.—ILLUSTRATIONS OF CANE.

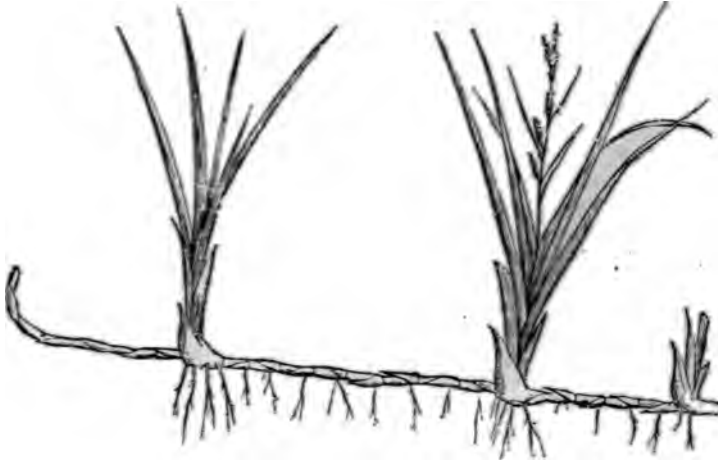


FIG. 341.

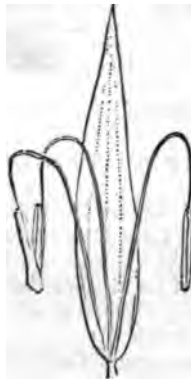


FIG. 342.

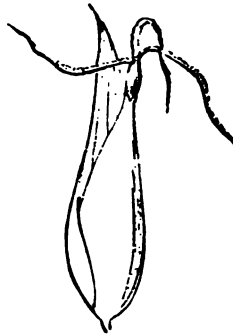


FIG. 343.

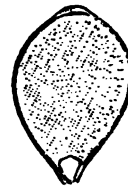


FIG. 344.

Fig. 341.—Underground stem, sending up leafy and flowering stems.  
 Fig. 342.—Male flower. Magnified.  
 Fig. 343.—Female flower. Magnified.  
 Fig. 344.—Section of seed. Magnified.

It is a curious fact that while the annual production of cane sugar in the world is now about 4,000,000,000 pounds, yet five hundred

years ago it was but little known to our European ancestors, and even a century and a half ago it was one of the luxuries. (Simmonds.)

*Sorghum vulgare*, Chinese Sugar Cane, a native of India, has within a few years been brought into cultivation in the United States for its sweet juice, from which molasses and sugar are made. One variety of this species is the Broom Corn, used in the manufacture of brooms.

Several species of Bamboo (*Bambusa*, sp.) growing in India become so large as to supply materials for building the houses of the natives.

*B. arundinacea* sometimes attains the height of 30 metres (100 ft.). Its uses are almost innumerable.

**Order Cyperaceæ.**—The Sedge Family. Herbaceous plants, with three-angled solid stems, bearing alternate three-ranked leaves, with entire sheaths. (Figs. 341-4.)

There are about two thousand species of sedges, which are distributed throughout the world. They grow in tufts, never forming a continuous mat, and generally prefer wet localities. They are of little value to man, and their stems contain so little nutritious matter that they are eaten only to a limited extent by animals.

*Cyperus esculentus*, the Chufa, a native of the Mediterranean region, is somewhat cultivated for its small, sweet-tasting tubers.

*Cyperus textilis* is used in India for making ropes and mats; in Egypt other species are used for the same purpose.

*Papyrus antiquorum*, Papyrus, is a tall growing plant with stems 2-3 cm. (1 inch) in diameter. It is a native of Egypt and the adjacent countries, and from it the inhabitants anciently made paper by slicing its cellular pith, and afterward hammering and smoothing it.

**553. Cohort II. Restiales.**—This includes three orders of mostly tropical plants bearing glumaceous flowers.

**Orders Restiaceæ, Eriocaulonaceæ, and Flagellariæ.**

**554. Cohort III. Commelinales.**—Plants with a hexamerous perianth, in two whorls, the inner colored and petaloid.

**Orders Mayaceæ, Xyridaceæ, and Commelinaceæ.**

The latter contains the well-known Spiderwort *Tradescantia*, sp.).

**555. Cohort IV. Pontederales.**—Marsh plants with a gamophyllous petaloid perianth.

**Orders Philodreæ, Pontederiaceæ, and Rapateæ.**

**556. Cohort V. Liliales.**—Plants with a hexamerous (rarely tetramerous) perianth, the parts united or free, and usually petaloid.

**Order Juncaceæ.**—The Rushes. Natives of temperate and cold

climates. The leaves and stems are woven into matting and chair bottoms, and the pith is used for the wicks of candles (rush-lights).

**Order Liliaceæ.**—The Lily Family. Perennial, mostly herbaceous plants, with entire leaves, and generally showy flowers. The species, of which there are about two thousand, are distributed in all climates. Some of these are valuable as food, others furnish useful medicines, while many are among our finest ornamental plants.

The more important food plants are the following :

*Allium Cepa*, the Onion, a native probably of the Mediterranean region, is grown throughout the world.

*Allium Porrum*, the Leek, *A. sativum*, Garlic, *A. ascalonicum*,

FIGS. 345-8.—ILLUSTRATIONS OF FRUITILLARIA.

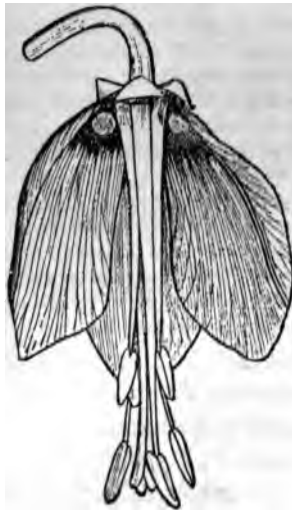


FIG. 345.

Fig. 345.—Section of flower.

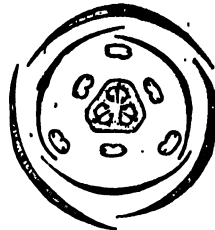


FIG. 346.



FIG. 347.

Fig. 347.—Section of ovary.



FIG. 348.

Fig. 348.—Ovule.

Shallot, and a few other species, all natives of the Old World, are considerably used.

*Asparagus officinalis*, Asparagus, is a native of the Atlantic and Mediterranean coasts of Europe, and of the sandy plains of Central and Western Asia. It has been cultivated in England for upwards of two thousand years, but it is an interesting fact that in all that time it has exhibited very little variation.

Among the medicinal plants may be mentioned

*Aloe vulgaris*, of the Mediterranean region, and other species in

Southern and Eastern Africa, the inspissated juice of whose leaves constitutes the drug Aloes.

*Smilax officinalis*, of South America, and other species, furnish Sarsaparilla root.

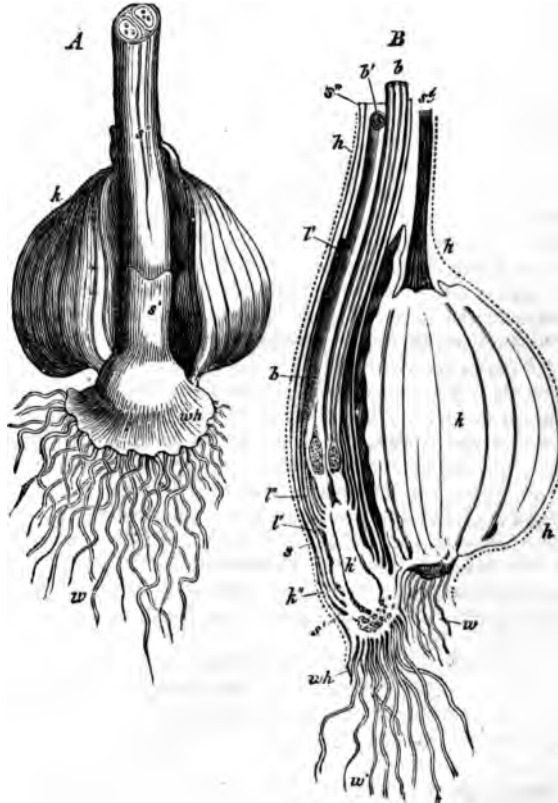


Fig. 349.—Underground parts of *Colchicum autumnale* at the time of flowering. *A*, front view; *k*, old corm; *s'*, *s''*, scales surrounding flower stalk. *B*, section showing new stem, *N'*, with rudimentary leaves, *l'*, *l''*; the very long tubular flowers, *b*, *b'*, spring from near the summit of the new stem, *N'*. The following spring *N'* will elongate and carry the fruit, and leaves *l'*, *l''*, above ground; the lower part of *N'* will enlarge into a corm like *k'*, while at *k''* a new plant will form as a lateral bud.—After Sachs.

*Scilla maritima*; the sliced bulb of this Mediterranean sand plant is the drug Squill.

*Veratrum album*, the White Hellebore of the mountains of Central

Europe, and *V. viride*, Green Hellebore of the Eastern United States, are poisonous emetics. The rhizome is officinal.

Ornamental plants:

*Asphodelus luteus* is the Asphodel of Southern Europe.

*Agapanthus umbellatus*, the Love Flower of the Cape of Good Hope, is a beautiful green-house plant, bearing pale blue flowers.

*Colchicum autumnale*, the "Meadow Saffron" or "Autumn Crocus" of Europe, is curious for its producing leaves in the spring, and then, long after these have died down, in the autumn sending up one or two long-tubed pale flowers, which soon wither away; the following spring, by the lengthening of the underground stem, the seed-pod is carried up, along with the green leaves (Fig. 349). The corms of this plant were formerly in some repute as medicines.

*Convallaria majalis*, the Lily of the Valley, is a native of woodlands and shady places in England, Europe, and Siberia.

*Dracæna Draco*, the Dragon Tree of Western Africa and the adjacent islands, is cultivated as a curiosity in green-houses. A tree of this species on the island of Teneriffe was, at the time of its destruction by a hurricane in 1867, upwards of 20 metres (70 ft.) high, and 5 metres (16 ft.) in diameter, and from its known slow growth it must have been many hundreds, possibly some thousands, of years old.

*Fritillaria imperialis*, the Crown Imperial, a native of the south of Europe and Western Asia, is a showy plant.

*Funkia*, sp., and *Hemerocallis*, sp., the Day Lilies, the former from China and Japan, the latter from Southern Europe, and *Hyacinthus orientalis*, the Hyacinth of Asia Minor, are in common cultivation.

*Lilium*—many species. The True Lilies. Aside from our native species, *L. Philadelphicum*, *L. Canadense*, and *L. superbum*, which deserve cultivation, the following are commonly found in gardens:

*L. bulbiferum*, the Orange Lily, from Southern Europe; flowers orange.

*L. tigrinum*, the Tiger Lily, from China; flowers orange-red.

*L. Pomponium*, the Turban Lily, from Europe; flowers red.

*L. Chalcedonicum*, the Red Lily, from Asia Minor; flowers red.

*L. Martagon*, the Turk's Cap Lily, from Europe; flowers flesh-colored.

*L. speciosum*, the Showy Lily, from Japan; flowers rose-colored.

*L. auratum*, the Golden Lily, from Japan; flowers white and golden.

*L. candidum*, the White Lily, from Asia Minor; flowers white.

*L. Japonicum*, the Japan Lily, from Japan; flowers white.

*L. longiflorum*, the Long flowered Lily, from Japan; flowers white.

*Myrsiphyllum asparagoides*, a delicate climber from the Cape of Good Hope, is grown in windows and conservatories under the name of *Smilax*.

*Ornithogalum umbellatum*, the Star of Bethlehem, is a native of Central Europe.

*Polygonum tuberosum*, the Tuberose, a native probably of the East Indies, bears a tall spike of fragrant white flowers. It is sometimes placed in the order Amaryllidaceæ.

*Ruscus aculeatus*, the Butcher's Broom of England and Southern Europe, a curious shrub, with flat leaf-like branches, is rarely cultivated with us.

*Tritoma ucaria*, of the Cape of Good Hope, bears a tall spike of red flowers, and hence receives in cultivation the name of the "Red-Hot Poker Plant."

*Tulipa Gesneriana*, the Tulip, is a native of the Levant. It was brought into Europe about three hundred years ago, and originally bore yellow flowers, but under long culture it has developed numberless varieties. To the Dutch we owe much of the improvement in this flower; in the first half of the seventeenth century throughout Holland so much attention was given to its culture, and such high prices paid for single bulbs of the finer varieties, that a speculative mania (known as the "tulipomania") arose, resembling the wildest of modern grain or stock manias.

*Yucca*, of several species, known by the name of Adam's Needle, Spanish Bayonet, Bear Grass, etc., is a genus of fine ornamental plants, natives of the warmer parts of America. The strong fibres are sometimes made into cordage. The roots contain *saponin*, and are used by the Mexicans instead of soap for washing.

*Xanthorrhœa* includes the curious Grass Gum Trees of Australia.

**557.—Cohort VI. Arales.**—A group of dissimilar plants, some being large trees, and others microscopic floating herbs.

**Order Lemnaceæ.**—The Duckweeds. These smallest of Phanerogams consist of floating disks (thalli), with no distinction of leaf and stem, bearing one or several roots beneath (in *Wolffia*, however, no roots). They are parenchymatous throughout, or with only rudimentary vascular tissues. Their flower-clusters are sunken into pits in the top or edge of the disks, and consist of one or two stamens and a single pistil, representing as many reduced flowers. There are about twenty species, widely distributed throughout the northern hemisphere. We have eight or ten species in the United States. (Figs. 350-2.)

**Order Aroidæ.**—The Arum Family. Herbs often large and palm-like in appearance, with large leaves having reticulated venation. Inflorescence generally surrounded by a spathe. Of the Aroids there are about 1000 species, distributed mostly in tropical countries, where they sometimes attain a height of several metres (6-12 feet); in temperate climates they are much smaller. They possess an acrid juice, which may be poisonous.

Some of the species have been used in medicine, among which are the Indian Turnip (*Arisæma*), and Sweet Flag (*Acorus*).

*Calocasia antiquorum*, a large plant of the tropics, is there grown for its fleshy farinaceous corm. It is grown with us for its fine foliage.

*Richardia Africana*, the so-called Calla-lily, or Ethiopian Lily, a native of the Cape of Good Hope, is a common green-house plant.

*Symplocarpus fatidus*, the Skunk-cabbage of the Northern United States, is remarkable for the mephitic odor of its bruised leaves.

*Amorphophallus Titanum*, an Aroid discovered in 1873 by Beccari in

FIGS. 350-2.—ILLUSTRATIONS OF LEMNA.

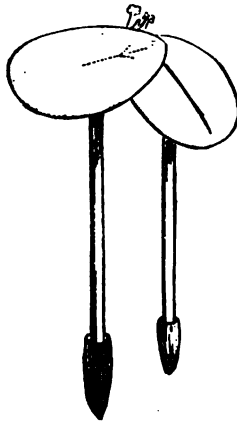


FIG. 350.



FIG. 351.

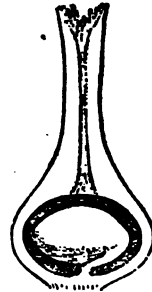


FIG. 352.

Fig. 350.—Two plants of *L. minor*. Magnified.

Fig. 351.—Three flowers in a spathe.

Fig. 352.—Section of pistil.

Sumatra, has an enormous spathe, 1.7 metres (6 feet) in depth, and 83 cm. (2½ feet) in diameter.

**Order Typhaceæ**, represented by the two genera *Typha* and *Sparganium*.

**Order Pandanaceæ**.—Mostly tropical plants, some of them of a tree-like aspect.

*Pandanus* includes the Screw Pines of the East Indies, so called from the spiral arrangement of their clustered leaves.

*Coriudovica palmata*, a Central American plant, with palmate radical leaves borne on petioles three metres (8-10 feet) long, is important as furnishing the material from which the famous Panama hats are made.

**558.—Cohort VII. Palmales.**—Shrubs or trees with divided (rarely simple) leaves. Flowers in a spadix.

**Orders Nipacæ and Phytelephasieæ**, both of the tropics. In the latter, *Phytelephas macrocarpa*, of Central America, is remarkable for the ivory-like endosperm in its large seeds; hence its name of Ivory Nut.

**Order Palmacææ.**—The Palm Family. Trees, shrubs, or woody climbers; natives almost exclusively of the torrid zone, or the adjacent

FIGS. 353-6.—ILLUSTRATIONS OF PALMACÆÆ.

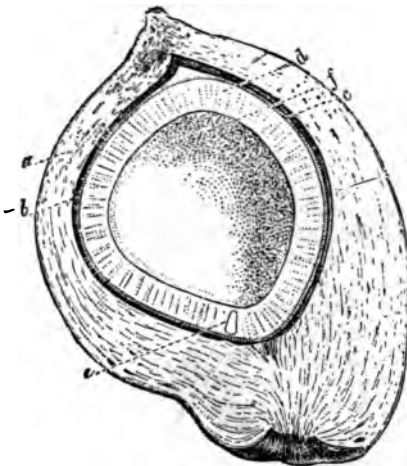


FIG. 353.

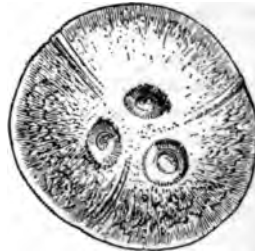


FIG. 354.

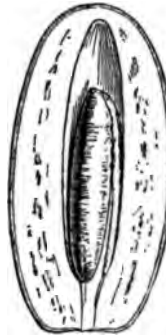


FIG. 355.



FIG. 356.

Fig. 353.—Fruit of Cocoa-nut. *a*, exocarp; *b*, endocarp; *c*, testa; *d*, endosperm; *e*, embryo; *f*, milk cavity.

Fig. 354.—Cocoa-nut seen from below.

Fig. 355.—Vertical section of a Date, showing seed inside.

Fig. 356.—Seed of Date in cross-section, showing embryo.

hotter portions of the temperate zones, being rarely found beyond 40° North and 35° South latitude. The arborescent species are among the most striking and majestic of plants; their long cylindrical stems frequently rise to the height of thirty metres (100 feet), bearing at their summits spreading crowns of large leaves, and drooping clusters of fruit. The whole number of known species is not far from one thousand.

The economic value of the Palms is very great; in fact it may be ques-



tioned whether any other order of plants (the Grasses possibly excepted) approaches them in the importance of the products they furnish. Every species appears to be useful, and the uses of some of the species may be reckoned by hundreds. In some countries every want of man is supplied by one or another of the palms.

**I. Tribe Coccoineæ.**—*Atalea funifera* is a Brazilian species of stout-growing trees, whose fibrous leaves are used in making ropes, mats, and coarse brooms. The nuts, known as Coquilla nuts, are seven to eight cm. (3 inches) long, very hard, and are used for making door-handles, bell-pulls, etc.

*Cocos nucifera*, the Cocoa-nut Palm, is a native of the coasts of tropical Africa, India, Malay, and islands of the Indian and Pacific Oceans. It is now, however, cultivated throughout the tropics. The tree varies in height from fifteen to thirty metres (50 to 100 feet), and bears long pinnate leaves. The nuts, which are borne in clusters of seven to ten or more, are the well-known cocoa-nuts of commerce. As a new cluster is pushed out every month, the annual yield of a single tree may be from 100 to 150 or more nuts, and this may continue for forty years. In some parts of India and other countries, the white albumen of the nut forms nearly the entire food of the natives, and the milk serves them for drink. In this country great quantities are used as a delicacy and for culinary purposes.

In cocoa-nut countries the uses of the root, stem, leaves, and fruit are said to be as numerous as the days in the year, sufficing for all the wants of the inhabitants. The root is used as a masticatory; the stem is used for the most diverse purposes, while the hard case of the base is used for making drums, and in the construction of huts, the tender terminal bud is highly prized as an article of food. The juice of the flower-stems is rich in sugar, and this, by fermentation, produces an excellent wine, and by distillation yields a spirit called arrack. From the sheaths and leaves the natives construct roofs, fences, baskets, buckets, ropes, mats, brooms, and numerous other articles. The fibre from the leaves and sheaths is imported into this country and made into "coir" ropes, floor-matting, brushes, and brooms, and used also for stuffing cushions. Even the hard shell is of use in the manufacture of cups and ornaments.

*Elais guineensis*, of West Africa, produces annually large quantities of pulpy fruits, each containing a hard nut. From these palm oil is obtained, which is used in Europe and the United States for making candles, for the manufacture of soap, and also to some extent for lubricating purposes.

**II. Tribe Coryphineæ.**—*Copernicia cerifera*, the Wax Palm of Brazil, attains the height of twelve metres (40 feet), with a diameter of stem of thirty cm. (1 foot). The hard wood takes a fine polish, and is used for veneering. The young leaves are coated with a waxy secretion which is used in England for making candles.

*Phoenix dactylifera*, the Date Palm, is a native of Northern Africa and Western Asia, now naturalized in the south of Europe. The tree is dioecious, and grows to the height of ten to twelve metres (40-50 feet), bearing a crown of leaves, each leaf being four to six metres (15-20 feet) long. The fruit is produced in large bunches, containing from twenty to thirty dates. Dates constitute a large portion of the food of the Arabs of the African and Arabian deserts. They are largely imported into the United States. They are prepared by gathering before they are quite ripe, and then drying in the sun.

The cultivation of the date palm has for ages been an object of first importance in Arabia and Northern Africa. The trees are hereditary, and are sold as estates, constituting the chief wealth of the inhabitants.

*Sabal Palmetto*, the Cabbage Palmetto, *S. serrulata*, the Saw Palmetto, *S. Adansonii*, the Dwarf Palmetto, and *Chamærops Hystrix*, the Blue Palmetto, all of the southeastern United States, and *Washingtonia filifera*, of California and Arizona, are our principal native palms.

**III. Tribe Borassineæ.**—*Borassus flabelliformis*, the Palmyra Palm, is a native of nearly all Southern Asia. It has large fan-shaped leaves, and a cylindrical stem rising to the height of fifteen to thirty metres (50-100 feet). Wine, or toddy, and sugar are made from the juice; the young sprouts of the flowering branches are used for food in the same manner as asparagus. From the stem is obtained Palmyra wood.

*Hyphæne thebaica*, the Doum or Gingerbread Palm, is a branching species of the upper Nile region. It produces fruits of the size of an apple and with the flavor of gingerbread. A resin derived from this tree is known as Egyptian Bdellium.

*Lodoicea sechellarum*, the Double Cocoa-nut of the Seychelle Islands in the Indian Ocean, is a giant among the palms. It attains the height of thirty metres (100 feet), its stem being forty-five to sixty cm. (1½ to 2 feet) in diameter. It produces large oblong nuts, which have the appearance of being double, and which weigh from thirty to forty pounds. They are borne in bunches of nine or ten in number, so that a whole bunch will often weigh 400 pounds. It takes ten years to ripen the fruit, the albumen of which is similar to that of the common cocoa-nut, but it is too hard and horny to serve as food. The leaves are made into hats, baskets, etc. The demand for the leaves for these uses has become so great that the trees are cut down in order to obtain them, and as no care is taken to form new plantations, it is feared that this palm will eventually become extinct.

**IV. Tribe Calameæ.**—*Calamus Rotang* and several other species include the Rattan or Cane Palms of India and the Malayan Islands. They have slender reed-like stems which grow to a great length, often from sixty to one hundred or more metres (200-300 feet), and are imported into Europe and the United States for making chair-bottoms, umbrella-ribs, etc.

*Calamus Draco*, of the same region as the preceding, yields a reddish resinous substance known as Dragon's Blood, and which is a secretion coating the surface of the small fruits. Dragon's blood is used for coloring varnishes and for staining horn.

*Sagus lavis* and *S. Rumphii*, Sago Palms, are trees nine to fifteen metres (30-50 feet) high, natives of Siam, the Indian Archipelago and other islands of the East. The sago is obtained by splitting the trunks and extracting the soft white pith; this is thrown into tanks of water, in which it is repeatedly washed and strained until a pure pulpy paste is obtained. In this state, in order to preserve it, the natives keep it under water, and it forms a large proportion of their food. For exportation it is dried and granulated through sieves. A tree fifteen years of age yields from six to eight hundred pounds of this nutritious material.

**V. Tribe *Arecinæ*.**—*Areca Catechu*, the Betel Palm of Cochin China and the Malayan peninsula and islands, produces a fruit of the size of a hen's egg, which is the famous Betel Nut or Pinang of the far East. The nut is cut into pieces and rolled up with lime, gambier, etc., in a leaf of the betel pepper, and chewed as tobacco is in this country.

*Caryota urens*, of India, is one of the wine or "Toddy" palms. It grows to the height of fifteen to eighteen metres (50-60 feet), and has a large crown of compound winged leaves. It is said that this tree will yield one hundred pints of toddy in twenty-four hours.

*Ceroxylon andicola*, the Wax Palm of the mountains of New Granada, is a tall tree, bearing large pinnate leaves five to six metres (15-20 feet) long. It is found on the mountain sides nearly to the snow line. The trunk is coated with a resinous wax, which is scraped off by the natives and used for making candles.

*Chamædorea* of several species, climbing palms of New Granada are interesting on account of their stems being used in forming suspension bridges.

*Saguerus saccharifer* of the Malayan Archipelago is a valuable Sago Palm. It is twelve to fifteen metres (40-50 feet) high, and bears enormous pinnate leaves; a tree grown in the Kew Gardens bore leaves twelve metres (40 feet) in length. Sugar is also obtained from the juice which flows from the wounded spadix.

**559. Cohort VIII. Potamales.**—Mostly herbaceous water plants, with all of the parts of the flower distinct; the embryo large, and endosperm wanting.

**Order Naiadaceæ.**—The Pond-weeds.

**Order Alismaceæ.**—The Water Plantain Family. This order is interesting from the fact of its evident relationship to the *Ranales* (Cohort 36) among Dicotyledons, as long ago suggested by Adanson, and insisted upon by Lindley. (Figs. 357-9.)

*Alisma* and *Sagittaria* are two common genera.

**560. Cohort IX. Triurales**, with one small and little known order.

**Order Triurideæ.**—Delicate, almost colorless herbs of the tropics.

**561. Cohort X. Dioscorales.**—Climbing herbs or under-shrubs, bearing reticulately veined leaves.

**Order Dioscoreaceæ.**—The Yam Family. Several species of *Dioscorea* produce edible tubers.

*D. sativa*, *D. aculeata*, and other species of India are extensively grown there and in the West Indies as potatoes are grown in cooler climates.

*D. Batatas* and *D. Japonica* are known as Chinese Yams.

*Testudinaria elephantipes*, of the Cape of Good Hope, is a curious

FIGS. 357-9.—ILLUSTRATIONS OF *ALISMA PLANTAGO*.

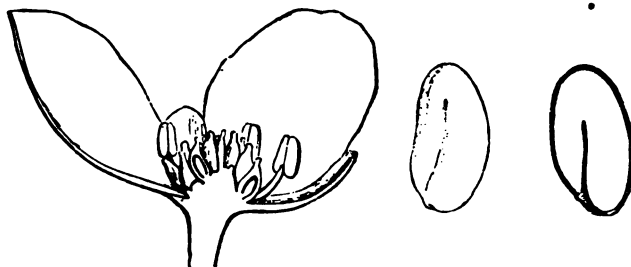


FIG. 357.

FIG. 358.

FIG. 359.

Fig. 357.—Flower cut vertically. Magnified.

Fig. 358.—Seed. Magnified.

Fig. 359.—Section of seed. Magnified.

green-house plant, having a large, woody, above-ground corm-stem, from which spring every year slender twining stems.

**562. Cohort XI. Narcissales.**—Plants with narrow, or equitant leaves, having parallel venation; seeds contain endosperm.

**Order Hæmodoraceæ.**—The Blood-wort Family.

**Order Amaryllidaceæ.**—The Amaryllis Family. Distinguished from the next order by having six stamens, and leaves which are equitant. The four hundred species are herbs of temperate and tropical climates; many possess a narcotic and poisonous principle.

*Agave Americana*, the Century Plant of Mexico, is now much grown in conservatories, and is said to be naturalized in Southern Europe. California and its native country it blooms from ten

fifteen years, but in cool climates it requires from thirty to seventy or more. The mature plant has a cluster of thick, sharp-pointed radical leaves, each about 2 metres (6 ft.) long, from the centre of which it sends up a flowering stem 10–15 cm. (4–6 in.) thick, and 5–6 metres (16–20 ft.) high, bearing hundreds of yellow flowers. The Mexicans cut out the central bud just before the lengthening of the flowering stem, and from the juice, which flows out in great abundance, obtain by fermentation the drink called “Pulque,” or by distillation the more generally used “Mescal.” The subterranean stems possess a detergent principle, and under the name of “Amole” are much used by the Mexicans in washing. The strong fibres in the leaves are used for cordage.

*Hæmanthus toxicaria*, of South Africa, has a poisonous bulb, which is used by the Hottentots for poisoning their arrows.

Many species are grown for the beauty of their flowers; among these may be mentioned:



Fig. 360. — Flower diagram of Iridaceæ.—After Sachs.

*Amaryllis*, of many species, mostly from South Africa and South America.

*Galanthus nivalis*, the Snowdrop, of Europe.

*Leucojum vernum*, the Snowflake, of Europe.

*Narcissus*, of many species; this includes the Daffodil, Jonquil, Polyanthus, etc., all natives of Europe.

**Order Iridaceæ.**—The Iris Family. The stamens are only three (by the abortion of an inner whorl, Fig. 360), and the leaves are equitant. The order contains five hundred species, which are mainly found in the south temperate climates, a smaller number occurring in north temperate regions. They contain a purgative principle, which has been used in medicine.

*Crocus vernus* and other species are commonly grown for their early spring flowers; the dried stigmas of *C. sativus* constitute the drug Crocus or Saffron used in medicine and also in dyeing.

*Gladiolus psittacinus* and other species, from the Cape of Good Hope, are deservedly popular as ornamental plants.

*Iris Germanica*, of Europe, and many other Old World species, are common in gardens.

Our native *I. versicolor*, *I. cristata*, and others, are also worthy of culture.

**563. Cohort XII. Taccades.**—This includes two small tropical orders of herbaceous plants.

**Orders Taccaceæ and Burmanniaceæ.**

**564. Cohort XIII. Orchidales.**—Herbs with a hexamerous (rarely trimerous) zygomorphic perianth; the stamens and style more or less confluent into a common column, and

the minute seeds containing a rudimentary embryo and no endosperm.

**Order Apostasiaceæ**, a small order of East Indian plants, which are interesting because of their evident relationship to the Orchids, from which they differ in having the style partially free from the stamens.

**Order Orchidaceæ.**—The Orchids. Terrestrial or epiphytic plants, whose stamens and style are completely united into a common column or *gynostemium*. The three thousand species are found in "all climates and in all situations but maritime and aquatic." (Hooker.)

This order has long been highly esteemed for the many curiously shaped and colored flowers it affords, and many hundreds of its species are to be found in cultivation in conservatories. They are interesting also from the fact that none of them are, unaided, capable of fertilizing their ovules, and appear in every case to be dependent upon insects for the transport of the pollen and its deposition upon the stigma.

This great order is usually divided into seven tribes, as under.

**Tribe I. Cypripediæ**, with two polliniferous stamens containing granular pollen (Fig. 362).

In this the genus *Cypripedium*, which contains our native Lady's-Slippers, is the most important. Some of the species, notably *C. spec'abile* and *C. acaule*, are greatly admired in cultivation.



Fig. 361.—*Orchis maculata*. A, a symmetrical vertical section of a flower bud. B, transverse section of the bud. C, transverse section of ovary. D, mature flower, with one sepal removed; x, axis of flower cluster; b, bract; s, sepal; p, petals; l, labellum; sp, its spur; a and pl, pollen-mass; h, its viscid disc; gs, the column (gynostemium); near gs is the stigma which projects toward h; f, inferior ovary, twisted in D; st, staminodes.—After Sachs.

**Tribe II. Neottieæ**, with a single dorsal anther, containing two or four soft pollen masses attached to a viscid disc. Our principal genus is *Spiranthes*.

**Tribe III. Arethuseæ**, with a single terminal anther, containing two or four powdery pollen masses.

Our native *Arethusa* and *Calopogon* are fine representatives of this tribe. The Vanilla plant (*Vanilla planifolia*, and other species) of tropical America, a climbing epiphyte, produces fleshy capsules 12 to 25 cm. (5-10 in.) long, which are highly aromatic, and much used in the manufacture of confections, beverages, medicines; etc. When first introduced into the East Indies, where it is now much grown, it failed to

perfect fruit; artificial pollination having been resorted to, however, the difficulty at once disappeared. (Fig. 363.)

**Tribe IV. Ophrydeæ**, with a single anterior anther, containing two stalked pollen masses, each attached to a viscid disc (Fig. 361).

Our pretty little *Orchis spectabilis*, and many species of *Habenaria*, are our principal representatives of this tribe. From the tubers of *Orchis mascula* and other European and Asiatic species, the starchy-mucilaginous and highly nutritious substance "Salep," is obtained.

**Tribe V. Vandeeæ**, with a single terminal or dorsal anther, containing waxy pollen masses attached to a viscid disc.



Fig. 362 — Sexual organs of the flower of *Cypripedium calceolus*, the perianth, *p*, removed. *A*, side view. *B*, back view. *C*, front view. *f*, the inferior ovary; *ga*, the column or gynostemium; *aa*, stamens; *s*, sterile stamen or staminode; *n*, stigma.—After Sachs.

We have no native representatives of this tribe. Many of the tropical species are of wonderful forms; indeed, as Mr. Darwin says of them, they are "the most remarkable of all Orchids." In some genera they assume the most curious forms, resembling insects of various kinds, birds, etc., etc. In *Catasetum succatum*, a declinous South American species, when certain sensitive parts of the column of the male flower are touched by an insect, the pollen masses are by a peculiar contrivance thrown out forcibly in such a direction as to strike the insect, to which it adheres by a viscid disc, and is thus carried to and brought in contact with the stigma of the female flower.

**Tribe VI. Epidendreeæ**, with a single terminal anther, containing stalked, waxy pollen masses, these not attached to a viscid disc. To this tribe belong in the United States *Tipularia*, *Bletia*, and *Epidendrum*, the latter an epiphyte, occurring only in the Southern States.

Of the exotics, *Calogyne*, *Lælia*, *Cattleya*, etc., are to be seen in conservatories.

**Tribe VII. Malaxideæ**, with a single dorsal, terminal, or anterior anther, which contains four stalkless, waxy pollen masses, not provided with a viscid disc.

*Calypso*, *Liparis*, *Corallorhiza*, and other genera occur in the United States; the last named appears to be parasitic. Among the many exotics may be mentioned *Bulbophyllum*, *Dendrobium*, *Malaxis*, etc.

**565. Cohort XIV. Amomales.**—Herbs (some almost arborescent) with hexamerous and mostly zygomorphic perianth; stamens six, generally from one to five only polliniferous.

**Order Bromeliaceæ.**  
—The Pine-apple Family. Distinguished from the next by the regular flowers and six perfect stamens. About two hundred species of almost entirely tropical plants constitute this order. But one genus (*Tillandsia*) is represented in the Southern United States; of the eight or ten native species, the Long Moss (*T. usneoides*) of the Southern Atlantic coast is the best known. It is used in upholstery and in the manufacture of mattresses.

*Ananassa sativa*, the Pine-apple, supposed to be a native of Brazil, is now cultivated throughout the world. In cool climates it is grown in hot-houses, and it is said that these are much better than those grown out of doors in warm climates. The fleshy fruits are aggregated into solid cone-like masses (Fig. 364), the well-known Pine-apples of commerce.

**Order Scitamineæ.**—The Banana Family, with zygomorphic perianth, and one to five, very rarely six, perfect stamens. Three sub-orders are well marked.

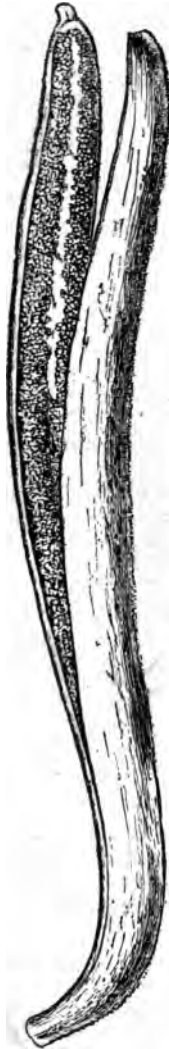


Fig. 363.—Ripened ovary of *Vanilla*, split open and showing the seeds.



Fig. 364.—Spike of the fruits of the Pine-apple (*Ananassa sativa*) terminated by a tuft of leaves.



part such that the veins rarely are parallel to each other, and in their anastomosing they form an irregular net-work.

The germination of Dicotyledons may be illustrated by a couple of examples. In the seed of the Windsor Bean (Fig. 367) the embryo entirely fills up the seed-cavity, the endosperm having all been ab-

FIGS. 367-8.—GERMINATION OF DICOTYLEDONS.

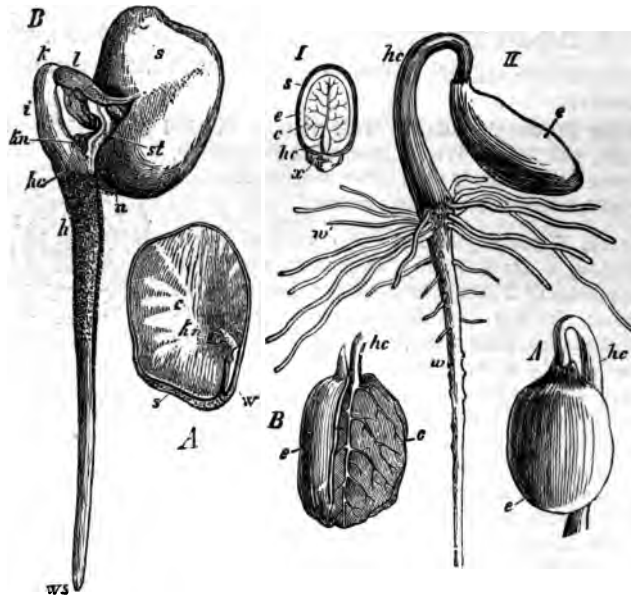


FIG. 367.

FIG. 368.

Fig. 367.—*Vicia faba*. A, seed with one cotyledon removed; c, remaining cotyledon; kn, the plumule; w, the radicle; s, seed-coat. B, germinating seed; s, seed-coat, partly torn away at l; n, the hilum; st, petiole of one of the cotyledons; k, curved epicotyledonary stem; hc, short hypocotyledonary stem; h, main root; we, its apex; kn, bud in the axil of one of the cotyledons.—After Sachs.

Fig. 368.—*Ricinus communis*. I, longitudinal section of the ripe seed. II, germinating seed with the cotyledons still inside of the seed-coat (shown more distinctly in A and B). s, seed-coat; e, endosperm; c, cotyledon; hc, hypocotyledonary stem; w, primary root; w', branches of root; e, caruncle, a peculiar appendage to the seeds of *Euphorbiaceae*.—After Sachs.

sorbed. The thick cotyledons lie face to face, and are attached below to the small stem of the embryo plant. The stem extends upward a short distance between the cotyledons, bearing a few rudimentary leaves and itself ending in a *punctum vegetationis* (Fig. 369, ss), the whole constituting the *plumule*. The downward prolongation of the stem (commonly but erroneously called the *radicle*, for it is not a little

root) ends in a very short root, which is continuous with the stem.\* Under the proper conditions of heat and moisture, the root elongates and pushes out through the micropyle of the seed-coat; at the same time, the stalks of the cotyledons elongate and thus bring the plumule outside of the seed-coat, the cotyledons alone remaining. During the first few days of its growth the young plant is nourished by the starch in the cotyledons, which in this species remain during the whole process of germination beneath the ground enclosed in the seed-coat. In the common Field Bean (*Phaseolus*) the germination is the same, excepting that the hypocotyledonary stem elongates, and brings the cotyledons which have slipped out of the seed-coat above the ground.

The seed of *Ricinus* (the Castor Oil Plant) contains a large embryo surrounded by a thin layer of endosperm (Fig. 368, I). In its germination the root and hypocotyledonary stem elongate, and thus bring the seed-coat with the contained cotyledons above the ground (Fig. 368, II). The cotyledons remain within the seed-coat until they have absorbed all of the endosperm; when this is accomplished the empty seed-coat falls away, and the freed cotyledons expand and assume to some extent the function of ordinary foliage leaves.

The venation of the leaves of Dicotyledons is easily studied by macerating them so as to remove the parenchyma (mesophyll), leaving only the fibro-vascular bundles. While there is as a rule a general likeness between them, there is yet an almost infinite diversity in the

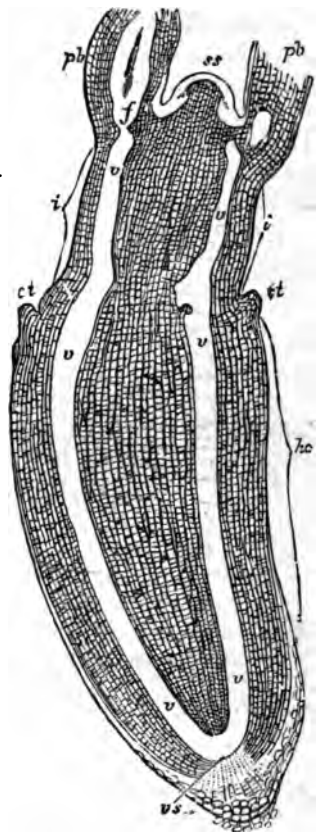


Fig. 369.—Longitudinal section of the axis of the embryo in the ripe seed of *Phaseolus multiflorus*, parallel to the cotyledons. *ss*, apex of the stem; *ws*, of the root; *ct*, swelling near insertion of cotyledons; *i*, the first internode; *pb*, the petioles of the first foliage leaves; *e, v, f*, procambium of the fibro-vascular bundles; *hc*, hypocotyledonary portion of the stem (the brace is too long in the figure).  $\times 30$ .—After Sachs.

\* In some old books, and even a few recent ones, a structure called the collar or *collum* is spoken of. Dr. Gray very properly defines it as

details. The general disposition of the smaller veins is well illustrated by Fig. 369a.\*

**568.**—The sub-class Dicotyledones is composed of thirty-six cohorts, containing in all from 150 to 200 natural orders. For convenience, the cohorts are separated into three artificial groups—the Apetalæ, Gamopetalæ, and Choripetalæ (Polypetalæ)—an arrangement which does violence to nature, separating widely many orders which are evidently closely related to each other.

**I. APETALÆ.** Plants whose flowers generally have but a single floral envelope (calyx), this even, in some cases, wanting.

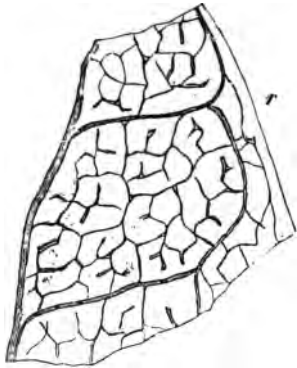


Fig. 369a.—Fragment of a leaf of a Dicotyledon (*Psoralea bituminosa*), showing reticulated venation. *r*, margin of leaf.  $\times 40$ .—After De Bary.

**569. Cohort 1. — Santalales.** Herbs, shrubs, or trees, mostly parasitic, with inferior ovary, generally naked ovules—*i.e.*, no integuments—and seeds usually containing endosperm.

**Order Balanophoræ.** — Fleshy leafless parasites, mostly of the tropics. One species, *Cynomorium coccineum*, of the Mediterranean region, is sometimes eaten.

**Order Santalacæ.**—Leafy herbs, shrubs, or trees, mostly parasitic, numbering about 200 species, which are distributed in temperate and tropical regions.

*Comandra umbellata*, a perennial herb, is our most common representative of the order.

*Santalum album*, the Sandalwood Tree of South Asia, attains a height of seven to eight metres (25 feet). Its dark red wood is used in cabinet-making, and for burning incense in Buddhist temples. Other species from the Pacific islands also furnish sandalwood.

The Quandang Nut of Australia is the edible fruit of a small tree, *Fusanus acuminatus*.

“the name of an imaginary something intermediate between primary stem and root.”

\* The student who wishes to study this subject fully should consult the papers of Dr. Ettingshausen, published in *Denkschriften* and *Sitzungsberichte Wien. Kais. Akad. Wissen.* They are excellently illustrated with many “nature printed” plates.

**Order Loranthaceæ.** The Mistletoe Family. Evergreen shrubs, parasitic upon other Dicotyledons. About 450 species are known; these are mostly tropical.

*Viscum album*, the Mistletoe of England, Europe, and Northern Asia, grows abundantly upon the apple and many other trees, rarely, however, upon the oak. The viscid fruits are used in making bird-lime, and its twigs and branches are much used in Christmas decorations in England. It was held sacred by the Druids, who made use of it in their religious ceremonies.

*Phoradendron flavescens*, the American Mistletoe of the Southern United States, is well known. On the Pacific coast, a variety of this species is common on the oaks.

Six species of *Arceuthobium*, small brown branching parasites on Conifers, are known in the United States. *A. pusillum* occurs in the Northern States.

**570. Cohort II.—Quernales.** Trees and shrubs, not at all parasitic, with diclinous flowers, mostly in catkins, inferior ovaries, and seeds destitute of endosperm.

**Order Cupuliferæ.** The Oak Family. Trees or shrubs with simple leaves; fruits (nuts), one-celled, one-seeded, one to three enclosed in an involucre. This valuable order contains about 300 species, which are distributed mainly in the Northern Hemisphere; in the Southern Hemisphere they occur in Chili, New Zealand, and the mountains of South Australia. Most of the species are astringent, which is due to the tannin they contain.

The order is of great economic importance on account of its valuable wood, which is used not only as a fuel, but still more in the manufacture of implements and utensils, and in the construction of houses, ships, etc. It is divided into two sub-orders, which are sometimes regarded as orders.

**Sub-Order Coryleæ.** Shrubs and small trees.

*Carpinus Americana*, the Blue Beech, or Hornbeam, is a small native tree with white, fine-grained, hard wood. As the European *C. betulus* is used in turnery, doubtless our species might be also.

*Corylus Avellana*, the Filbert, is a shrub growing wild in Europe and Western and Northern Asia, and now cultivated in Europe and the United States. It is grown principally for its edible nuts, although the straight rod-like branches are largely used in making hoops, crates for merchandise, etc. White Filberts, Red Filberts, Cob-nuts, and Barcelona-nuts are some of the cultivated varieties. *C. Americana*, the common wild Hazel-nut of the Eastern United States, is much like the preceding, but smaller in size of shrub and nuts. Its nuts are gathered and eaten, and are occasionally found in the markets.

*Ostrya Virginica*, the Ironwood of the Eastern United States, is a small tree having a hard, fine-grained wood, which is valuable for fuel.

Although capable of many uses in the arts, it has been, to a great extent, neglected. The trunks of the young trees are much used for levers in saw-mills and log-yards, hence one of its popular names, Lever-wood.

**Sub-Order Quercineæ.** Mostly large trees.

*Castanea vesca*, the so-called Spanish Chestnut, is a native of Asia

FIGS. 370-74.—ILLUSTRATIONS OF *QUERCUS ROBUR*.

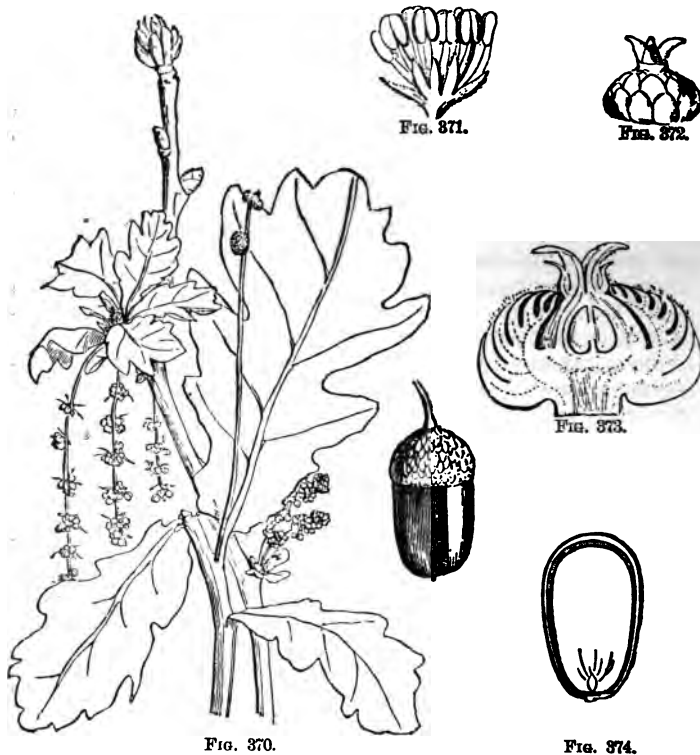


Fig. 370.—Male and female branches, with a ripe fruit at the side.  
 Fig. 371.—Male flower. Magnified.  
 Fig. 372.—Female flower. Magnified.  
 Fig. 373.—Female flower, in vertical section. Magnified.  
 Fig. 374.—Vertical section of fruit.

Minor and the region eastward to the Himalayas. It is found in Central and Southeastern Europe, but it was probably introduced from the East 2000 or more years ago. It furnishes a valuable coarse-grained timber, and its fruits are the "Spanish Chestnuts" of the markets.

Several varieties occur in North Africa, Japan, and North America. *C. vesca*, var. *Americana*, our native Chestnut, of the Eastern United States, is a large tree, with smaller and sweeter nuts than the Old World variety. Its wood, which is light, coarse-grained and easily worked, is highly prized for making doors, cases, certain kinds of furniture, etc.

*Fagus sylvatica*, the Beech of Europe and Western Asia, supplies a hard wood much used in chair-making, turnery, and in the manufacture of wooden shoes. Purple Beech, often cultivated as a curiosity, is a variety of this species.

*F. ferruginea*, the common Beech of the Eastern United States, is a large spreading tree; its wood is reddish in color, and of great hardness when dry, and is used in making carpenters' tools, and for other purposes. Its nuts, known as Beech-nuts or Beech-Mast, are nutritious, and, where abundant, are used for fattening swine.

In Southern South America, New Zealand and Australia, there are six or seven evergreen species of this genus.

The genus *Quercus* includes the Oaks, in all about 250 species, which are widely distributed in the Northern Hemisphere; none occur beyond the equator. De Candolle (*Prodromus*, Vol. XVI.) divides the genus into six sections, four of which are exclusively Southeastern-Asiatic.

SECTION I.—The Scaly-Cupped Oaks. These include the common oaks of Europe and America. They are again subdivided into two subsections—viz., the White Oaks and the Black Oaks.

(a) *White Oaks*.

*Quercus Robur*, the British Oak, of England and the Continent of Europe. It is a stately tree, supplying a most valuable timber for all kinds of constructive purposes, in naval, civil, and military engineering. It is considered to be superior to all other kinds of oak for its timber. The bark contains tannin, and is much used in tanning. (Figs. 370-4.)

*Q. Lusitanica*, var. *infectoria*, of the Levant, produces the Nutgalls of commerce; these are morbid growths on the petioles or midribs of the leaves, resulting from punctures made by an Hymenopterous insect of the genus *Cynips*. Their value lies in the tannin they contain.

*Q. alba*, the White Oak of the Eastern United States, stands next to *Q. Robur* in the value of its timber, which is used in this country as British Oak is in Europe.

*Q. tirens*, the Live Oak of the Southeastern United States, and extending westward to Texas, is a large tree, twelve to twenty metres (40-60 feet) high, with spreading branches, bearing small entire evergreen leaves. Its hard and heavy wood is very strong and durable, and has been much used in ship-building.

*Q. chrysolepis*, the Cañon Live Oak of the cañons and mountain-sides of California, resembles the preceding in many respects, being like it an evergreen, and sometimes attaining a height of from twelve to six-

teen metres or more (40-50 feet). "It furnishes the hardest oakwood of the Pacific Coast, and is used in making ox-bows, ax-handles, etc." (Vasey).

*Q. Suber*, the Cork Oak, is found in Southern France, Spain, Italy, Sardinia, and, to a limited extent, in Northern Africa. It is a spreading topped tree, bearing oval, dentate evergreen leaves. Certain layers of cells in its bark retain their power of growth for a long time, and give rise to a thick mass of cork. This is removed every eight or ten years by making vertical and transverse cuts in the bark, and then peeling off all but the inner bark layers. Most of the supply of cork comes from Spain and Southern France. The tree might very profitably be grown in our Southern States and in California.

*Q. cerris*, the Turkey Oak of Southeastern Europe, is a fine tree with deciduous, lobed leaves, and bears a considerable resemblance to our native *Q. macrocarpa*, from which it differs, however, in requiring two years to mature its fruits. Its timber is much used for ship-building and other purposes.

(b) *Black Oaks.*

In this are the Black Jack (*Q. nigra*), the Red Oak (*Q. rubra*), Scarlet Oak (*Q. coccinea*), Quercitron Oak, (*Q. coccinea*, var. *tinctoria*), all of the Eastern United States. The timber obtained from these is coarse-grained, and not so durable as that of the white oaks; the two last furnish a yellow dye, Quercitron, which is derived from the bark. *Q. agrifolia*, the Field Oak of California is a broad-topped evergreen species. Its wood is of but little value.

SECTION II., the Spiny-Cupped Oak, includes but a single species, found in California.

*Q. densiflora*, the California Tan-bark Oak. This is a beautiful tree, often thirty metres or more in height (100 feet), with curious chestnut-like fruits.

The remaining sections contain eighty to ninety species, confined entirely to India, China, Japan, and the Malay Islands. They differ in many respects from our oaks.

**Order Juglandaceæ.**—The Walnut Family. Trees and shrubs with pinnately compound leaves; fruit a dry drupe, containing a hard, one-seeded nut (Figs. 380-382). This family includes about thirty species, about equally divided between North America and Asia. They possess an acrid aromatic principle, which has been used in medicine.

*Juglans regia*, the Walnut of the Old World, is a native of Asia Minor and the country eastward, but long cultivated in all parts of Europe, and, to some extent, in this country. The light brown wood is highly prized in England for cabinet-making, the manufacture of furniture, piano-cases, gun-stocks, etc. Its thin-shelled nuts are highly esteemed, and are imported from Europe in large quantities under the name of "English Walnuts." (Figs. 375-382.)

*J. nigra*, the Black Walnut of the Eastern United States, is a giant

tree, often forty to fifty metres (130-160 feet) in height. Its dark brown timber is fully as valuable as the preceding, and is used for the same purposes. It is exported in considerable quantities to England. Its

FIGS. 375-82.—ILLUSTRATIONS OF *JUGLANS REGIA*.



FIG. 375.



FIG. 376.



FIG. 378.

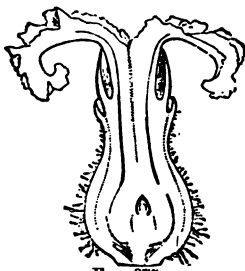


FIG. 377.



FIG. 379.

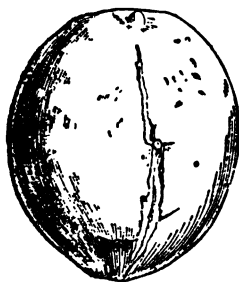


FIG. 380.



FIG. 381.



FIG. 382.

Fig. 375.—Female flower cluster. Fig. 376. Female flower. Magnified.  
 Fig. 377.—Female flower cut vertically. Magnified.  
 Fig. 378.—Male flower. Magnified. Fig. 379.—Male flower cluster.  
 Fig. 380.—Ripe fruit. Fig. 381.—Endocarp. Fig. 382.—Seed.



thick-shelled and stronger-tasting nuts are occasionally found in the markets.

*J. cinerea*, the White Walnut or Butternut, of the Eastern United States, is a smaller tree, furnishing a valuable lighter colored timber than the preceding.

Two small species occur in California, Arizona, and Texas.

*Carya a. ba*, the Shell-bark Hickory, and *C. sulcata*, both large trees, of the Eastern United States, furnish a white, tough, and hard timber, useful in the manufacture of agricultural implements, and for many other purposes where great strength is required. It is not well adapted to use in large masses, as it is liable to early destruction through decay and the ravages of wood-boring insects. The fruits, known as "Hickory-nuts," and highly prized for eating, are found in our markets, and are also exported to England.

*C. oliviformis*, a small tree of the Southern States, furnishes a thin-shelled edible fruit known as the "Pecan-nut."

Other species of *Carya* furnish valuable timber, and from the nuts of this and the preceding species valuable "nut-oils" used in painting are obtained.

**571.—Cohort III. Asarales.** Herbs, with mostly mon-oclinous flowers, inferior ovary, and seeds with integuments, containing minute embryo usually surrounded with endosperm.

**Order Rafflesiaceæ.**—Parasites upon the stems and roots of Dicotyledons. Twenty or more species are known, distributed throughout the hotter parts of the world.

*Rafflesia Arnoldi*, of Sumatra, is the most remarkable member of the order. It consists of a gigantic parasitic flower nearly a metre in diameter (3 ft.), with five mottled-red spreading petals. It is parasitic upon a woody climbing plant (*Cissus angustifolia*) nearly related to the Vine, and in its growth forms scarcely any stem, developing almost at once into a giant flower-bud. It was discovered in 1818 by Dr. Arnold.

**Order Aristolochiaceæ.**—Mostly tropical herbs, including about 200 species. Three species of *Asarum*, and three of *Aristolochia* occur in the United States.

**572.—Cohort IV. Nepenthales.** Climbing shrubs, with diclinous flowers, a superior three to four-celled ovary, whose many seeds contain an endosperm.

**Order Nepenthaceæ.**—Plants of the East Indies and Australia, of ten or twelve species, all belonging to the genus *Nepenthes*. The leaves are prolonged into a slender tendril-like organ, upon whose extremity there develops a hollow closed body, which finally becomes open by the separation of its apex in such a manner as to form a hinged lid (Fig. 383, *d, e, f*). In the cavities of these pitchers, as they

are called, a watery, slightly acid fluid is secreted; upon their borders are secreted honey or nectar drops, which attract insects, and these falling into the fluid within are soon dissolved by it, and then absorbed by the plant for its nourishment.

**573.—Cohort V. Piperales.** Mostly herbs, with spiked flowers and superior one-celled and one-seeded ovary.

**Order Ceratophylleæ.**—Aquatic herbs of the Northern Hemisphere.

**Order Chloranthaceæ.**—Shrubby plants, mostly of the tropics.

**Order Piperaceæ.**—The Pepper Family. Herbs, shrubs, or small trees, almost confined to the tropics; generally with a pungent and aromatic principle. Over 1000 species are known.

We have one species of *Saururus* in the Eastern, and one of *Anemopsis* in the Southwestern United States.

Two tropical genera, *Piper* and *Peperomia*, include nearly all the species, the first containing 620 and the second 382.

*Piper nigrum* is a climbing East Indian plant, with heart-shaped leaves; it bears spikes of berries, which, when gathered green and dried, constitute the Black Pepper of commerce. The ripe berries, when dried, constitute White Pepper. Pepper is now grown in the West Indies.



Fig. 383.—Two leaves of *Nepenthes ampullaria*. *a*, short petiole; *b*, blade or expanded part of leaf; *c*, tendril-like prolongation of midrib; *d*, *e*, pitcher; *f*, its lid. In the other leaf, which is younger, the lid has not yet separated from the apex of the pitcher.—After Duchartre.

*P. Cubeba*, whose dried unripe berries are known in pharmacy as Cubebs, is a native of the East Indies.

*P. Betle*, of the East Indies, is the Betel Pepper, whose bitter aromatic leaves are mixed with Areca-nut and lime to form a masticatory. (See Betel Palm, p. 466.)

From the thick rhizome of *P. methysticum* the inhabitants of many of the Pacific islands make a disgusting drink which is very intoxicating.

**574.—Cohort VI. Euphorbiales.** Plants with mostly diclinous flowers, with a superior two to many-celled ovary ; seeds containing endosperm.

**Order Lacistemaceæ.** Shrubs of tropical America.

**Order Geissolcmææ,** containing a single shrub, of Southwestern Africa.

**Order Penæacææ.** Evergreen shrubs of South Africa.

**Order Euphorbiaceæ.**—The Spurge Family. This vast group of upwards of 3000 species can not be defined by any one character. They may generally be distinguished by their three-celled ovaries and milky juice, although neither of these characters is universal throughout the order. The species range in size from small herbs to gigantic trees, and are distributed throughout all climates except beyond the Arctic Circle. They are much more abundant, however, in tropical countries than elsewhere. With few exceptions they possess an acrid principle, which is often poisonous.

Many of the species are of economic importance, a few of which only can be mentioned here.

*Manihot palmata* and *M. utilisissima*, slender plants of tropical America, and now cultivated in many tropical countries, have thick starchy roots. The starch, separated and washed, is imported under the name of Brazilian Arrowroot. Tapioca is prepared by heating the separated and washed starch upon hot plates. Cassava is made from the crushed roots by drying the pulp without separating the starch. These three substances are highly nutritious, and are much used as food by the natives, and are, moreover, largely imported into this country. Their value is all the more remarkable from the fact that the root of the second named species above is in its raw state deadly poisonous.

*Ricinus communis*, the Castor Oil plant, a native of India, is now widely grown for its oily seeds, from which Castor Oil is obtained by pressure. It is extensively grown in the Mississippi Valley. In Germany it is grown for its leaves, which are fed to silkworms. It is a beautiful ornamental plant, and when grown for this purpose is called the Palma Christa.

Croton Oil from *Croton Tiglium*, and Pinhoen Oil from *Jatropha Curcas*, are drastic medicines. Gum Euphorbium, the dried milky juice

of various African and Indian species of *Euphorbia*, Cascarilla Bark and Melambo Bark from species of *Croton* in tropical America, are more or less known in pharmacy.

*Hevea Guianensis* and other species of the genus, natives of the northern part of South America, furnish the important substance Caoutchouc, or India Rubber. The trees are from fifteen to thirty metres in height (50 to 100 ft.), and bear trifoliate leaves resembling those of the Scarlet-runner bean in size and shape. The natives make incisions into the trees, from which the milky juice exudes, and this evaporated constitutes the crude Caoutchouc. By heating the crude product with sulphur it is hardened, and is then known as "Vulcanized rubber."

*Euccaria sebifera*, the Tallow tree of China, now cultivated in the warmer parts of America, has its seeds coated with a white greasy substance, which yields a valuable tallow from which candles are made.

*Aleurites Moluccana*, the Candle Nut tree of India and the Pacific islands, produces a large oily fruit, which is itself burned and used as a candle, or from which a valuable oil is extracted.

The most valuable timber of the order is furnished by *Buxus sempervirens*, the Box tree of Europe and Asia. It is a small evergreen tree, with a very hard yellowish wood, invaluable in wood engraving, the manufacture of mathematical instruments, etc. Our chief supply comes from the Mediterranean ports. A dwarf variety of this species is used for bordering garden walks.

African Teak, a very heavy and hard wood from Africa, is supposed to be derived from *Oldfieldia Africana*, which has been doubtfully referred to this order.

Among the plants grown for ornament are many species of *Euphorbia*, an immense genus of 700 species, distributed very widely; in Africa they assume a Cactus-like aspect, having thick succulent stems. These and many other species are to be found in conservatories. The curious *Xylophylla*, with flat leaf-like branches, bearing flowers upon their edges, is also common.

The Sand Box tree of tropical America bears a curious many-celled fruit which when dry explodes with a loud report.

The juice of many of the species is poisonous when dropped upon the skin, or into a wound. The Manchineel tree (*Hippomane Mancinella*) of South Florida and the West Indies is extremely poisonous, but many of the stories told of it are fabulous.

Zebra Poison is the name applied to *Euphorbia arborea*; branches of it placed in water render it sufficiently poisonous to kill the animals which drink it.

**575.—Cohort VII. Amentales.** Woody plants, with dichlinous flowers, mostly in catkins; the one or two-celled ovary superior, and the seeds with no endosperm.

**Order Salicaceæ.**—The Willow Family. Dioecious trees and shrubs with naked flowers—*i.e.*, the perianth wanting. The species, of which there are 180, are principally found in the North Temperate and Arctic Zones; beyond the tropics they are rare, and none occur in

FIGS. 384-9.—ILLUSTRATIONS OF *SALIX CAPREA*.

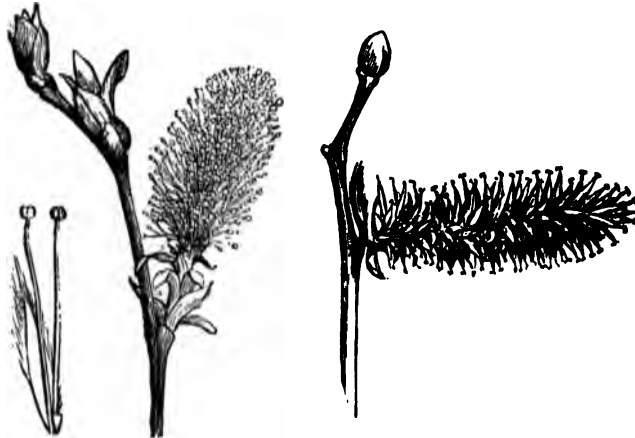


FIG. 384.

FIG. 385.



FIG. 386.

FIG. 387.

FIG. 388.

FIG. 389.

Fig. 384.—Male catkin and separate flower.

Fig. 385.—Female catkin.

Fig. 386.—Female flower. Magnified.

Fig. 387.—Cross-section of ovary. Magnified.

Fig. 388.—Ripe fruit and seed. Magnified.

Fig. 389.—Embryo. Magnified.

Australia and the South Pacific Islands. They contain a bitter astringent principle useful in medicine as a febrifuge.

Two genera only are known.

*Salix viminalis*, *S. purpurea*, *S. caprea*, and other species of the Old World, are cultivated for basket-making.

*S. Babylonica*, the weeping willow of Persia, is well known under cultivation.

*S. alba* and other large species of Europe furnish a light firm wood, much used for many purposes.

By charring the wood a fine charcoal is obtained, much used in the manufacture of gunpowder. In the prairies of the Mississippi Valley the species last named is planted in compact rows to serve for hedges and to break the force of the violent winds.

Some of the larger of our many native species might profitably be used for their light timber, which in some cases is quite durable.

*Populus Canadensis*, the Cottonwood of North America, is a very large tree, whose white wood is suited to many manufacturing purposes.

The "Lombardy Poplar," a variety of *P. nigra*, and a native probably of Western and Northern Asia, and the Abele tree (*P. alba*) of Europe, are commonly grown on large grounds.

**Order Casuarinaceæ.**—Leafless trees, with pendulous Equisetum-like jointed stems. Twenty-five species, mostly natives of Australia, are known. Some of them are large enough to supply a valuable timber for ship-building, and many are favorites for ornamental purposes in Australia.

**Order Myricaceæ.**—Monœcious or diœcious shrubs, often with a glandular waxy pubescence. The thirty to thirty-five species are widely distributed throughout the North Temperate Zone, and in tropical Asia and South Africa.

The berries of *Myrica cerifera*, the Bayberry, of the Eastern United States, and other species in Europe are covered with a wax, which is gathered and made into candles.

**Order Platanaceæ.**—The Plane Tree Family. A small group of five monœcious trees, with the flowers in globose catkins.

*Platanus occidentalis*, the Plane tree, Buttonwood, or Sycamore of the Eastern United States, is a large tree with thin white bark. Its reddish wood is valuable, and should be more used. A nearly related species occurs in California and two in Mexico. The fifth, *P. orientalis*, is the only Old World species.

**Order Betulaceæ.**—The Birch Family. Monœcious trees with flowers in slender catkins. The species, forty or more in number, are found throughout the North Temperate Zone, and in South America.

*Betula alba*, of Northern Europe, Northern Asia, and North America, is a useful species. Its wood is valuable for fuel, use in manufactures, and for making into charcoal. Its bark is made into shoes, boxes, etc.; it is used in tanning leather, and from it by distillation an oil is obtained which gives to Russia leather its peculiar scent. The people in the high north latitudes also use the cellular and starchy part of the bark for food.

The bark of *B. papyracea*, of the Eastern United States, is used by the Indians for making their "birch bark canoes."

The wood of species of *Alnus*, the Alders, is very durable when placed under the ground or water. It is also made into wooden bowls and other domestic utensils, and is in some places grown for making into charcoal.

**576.—Cohort VIII. Urticales.** Mostly diclinous plants, with superior one-celled ovary, and single seed mostly with an endosperm.

**Order Ulmaceæ.**—The Elm Family. Trees or shrubs of the North Temperate Zone, having mostly monoclinal flowers, and a watery juice. About one hundred and thirty species are known.

*Ulmus campestris*, the common Elm of Europe and Western Siberia, is a large tree, thirty to forty metres (100 to 130 ft.) high. Its timber is valuable for works under ground or in water, and is besides much used by wheelwrights. The tree is common in American gardens.

*U. Americana*, the American White Elm of the Eastern United States, and now much grown in Europe, is one of our finest looking trees, and deservedly popular as an ornament in large grounds. Its timber is valuable when used entirely under water or in the ground, or when kept continuously dry; otherwise it decays rapidly.

*U. fulva*, the Slippery Elm of the Eastern United States, supplies a valuable timber, and its mucilaginous inner bark is used for medical and surgical purposes.

*Celtis occidentalis*, the Hackberry of the Eastern United States, is a lofty tree which furnishes a white hard timber, which is not, however, very durable.

**Order Cannabineæ.**—This contains the two dioecious herbs, the Hemp and the Hop.

*Cannabis sativa*, the Hemp, is a tall herb, two to three metres (7 to 10 ft.) in height, indigenous in the northern parts of India, but now generally cultivated in all temperate and warm regions. Under the names of *gunja*, *bang*, *churrus*, *haschisch*, etc., the natives of India and Central Africa use the dried leaves, stems, flowers, and the resinous matter which develops on the plant. When smoked, or drank as an infusion, these are highly intoxicating. The fibre obtained from its bark is strong, and much used for cordage.

*Humulus Lupulus*, the Hop, a native of temperate Europe, Asia, and North America, is grown for its bitter principle, *Lupulin*, which develops in the female flower clusters, and which is much used in the manufacture of beer, ale, etc.

**Order Moraceæ.**—The Mulberry Family. Trees or shrubs, containing a milky juice. The order contains between 800 and 1000 species, and they are for the greater part natives of the tropics. Many

of them contain an acrid poisonous principle, while some are not only innoxious, but afford wholesome food.

*Artocarpus incisa*, the Bread Fruit tree, a native of the Pacific Islands, and now common in tropical countries, attains a height of from six to nine metres (20 to 30 ft.). The fleshy receptacle and agglomerated carpels form a mass as large as a man's head. This "fruit," when gathered a little before it is ripe, and baked, looks and tastes much like bread, and is largely eaten by tropical people. The Jack Fruit of India (*A. integrifolius*) is similar, but not so palatable.

*Ficus Carica*, the Fig, a native of Western or Southern Asia, has

FIGS. 390, 91.—ILLUSTRATIONS OF MORACEÆ.

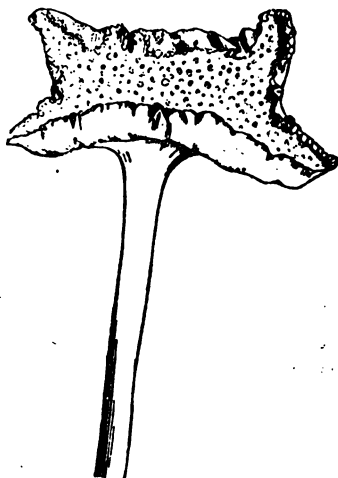


FIG. 390.



FIG. 391.

Fig. 390.—Fleshy concave receptacle of *Dorstenia*, bearing male and female flowers.  
Fig. 391.—Fleshy closed receptacle of *Ficus*, cut vertically, containing male flowers above and female below.

been cultivated for ages. It is now found in all tropical and sub-tropical countries. It is grown in the Southern United States and in California. The tree attains a height of from five to six metres (16 to 20 ft.), and bears pear-shaped closed receptacles (Fig. 391), inside of which are the minute flowers. The ripened and dried receptacles constitute the Figs of commerce. Our supply comes mainly from the Mediterranean Basin.

*Galactodendron utile* (*Brosimum utile*), a tall tree, twenty-five metres high (80 ft.), of Venezuela, whose milky juice is used by the natives as a substitute for milk, to which it bears a close resemblance. The tree is hence called the Cow Tree.



*Morus nigra*, the Mulberry tree of Persia, is now cultivated in Europe and the United States for its edible fruit masses. Its leaves are used to feed to silkworms, but not to so great an extent as those of *M. alba*, the White Mulberry, which has been used from time immemorial for this purpose in China.

*M. rubra*, a native of the Eastern United States, bears valuable fruits.

Several of the trees of the order yield Caoutchouc. The most important of these are *Ficus elastica* of India, and *Casti'loa elastica* of Mexico and the West Indies; the first named is a common greenhouse plant.

Gum Lac is a resinous exudation collected from an Indian species of *Ficus*, whose branches have been punctured by an hemipterous insect, *Coccus lacca*.

The wood of many species is valuable.

*Brosimum Guianensis*, of Guiana, produces the beautifully mottled and streaked Snakewood, much prized by cabinetmakers, and for making bows.

*Maclura aurantiaca*, a tree eight to fifteen metres (25 to 50 ft.) high, growing in Arkansas, Texas, etc., supplies a very hard wood used by the Indians for making bows, hence one of its names, "Bow-wood." Under the name of Osage Orange, it is much used as a hedge plant. Its wood yields a coloring matter used as a dye, and from *M. tinctoria*, of the West Indies, the dye known as Fustic is obtained.

The bark of many species yields tenacious fibres; thus from the Paper Mulberry (*Broussonetia papyrifera*), a Chinese and Japanese tree eight to fifteen metres (25 to 50 ft.) in height, the Chinese make paper, and the Pacific Islanders make cloth. One of the most remarkable is the Sack tree (*Antiaris saccidora*) of Western India; its bark is so tenacious that after beating, it may be removed in sections, which are used for sacks for carrying rice, etc.

The Upas Tree of Java (*Antiaris toxicaria*) is poisonous, but it is by no means as virulent as it has been described. It frequently grows in volcanic valleys partially filled with carbon dioxide and other noxious gases, and to this fact is doubtless due the marvellous stories told of it. However, from its juice the natives prepare a deadly poison for their arrows.

The Banyan Tree (*Ficus Indica*) is remarkable for its numerous adventitious roots, which grow down from its horizontal branches, and thus enable it to extend its top very greatly. One on the Nerbudda, with three hundred and twenty of such supporting roots, covers an area two hundred metres (650 ft.) in diameter.

**Order Urticacæ.**—The Nettle Family. Herbs, shrubs, or trees, with a limpid juice; they occur in all climates, but mostly in the tropics. More than five hundred species are known. Many of the species possess a valuable fibrous bark. (Figs. 392–7.)

*Bœhmeria nivea*, the China Grass or Ramie, a perennual herbaceous plant, may fairly rival Flax in the fine and durable fibres it produces. It has been introduced into the Southern United States and California. There is still some difficulty in separating the fibres from the woody portions of the plant, and this has prevented its more extensive use.

The Stinging Nettles include ten genera, of which the most important are *Urtica*, which includes our common species, and *Laportea*, represented by our Wood Nettle; to the latter belongs the Tree Nettle, *L. gigas*, of Australia, which reaches a height of from fifteen to forty metres (50 to 130 ft.), and whose sting is so severe as to produce dangerous results.

**577. — Cohort IX. Daphnales.** Mostly shrubs or trees, with monoclinalous flowers; ovary superior, one-celled, with a single seed containing no endosperm.

**Order Proteaceæ.**—A family of about 1000 species, confined almost entirely to the Southern Hemisphere, and occurring in greatest abundance in Australia and South Africa. Many species, especially of the genus *Banksia*, are cultivated in conservatories. A few furnish valuable timber.

*Grevillea robusta*, the Silk Oak of Australia, attains a height of twenty-four to thirty metres (80 to 100 ft.), with a diameter of two metres or more, and supplies valuable timber.

*Knightia excelsa* is a valuable New Zealand timber tree thirty metres (100 ft.) or more in height.

*Leucadendron argenteum*, the Silver Tree of the Cape of Good Hope, has silvery lanceolate leaves; its wood is much used for fuel.

*Protea grandiflora*, the "Wagen-boom" of the same region, is used by wheelwrights in the manufacture of wagon wheels.

**Order Elæagnaceæ.**—A small order, of sixteen species, of trees or

FIGS. 392-7.—ILLUSTRATIONS OF *URTICA URENS*.

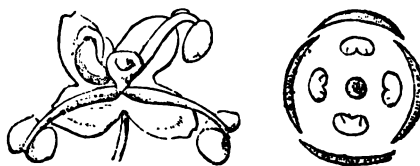


FIG. 392.

FIG. 393.

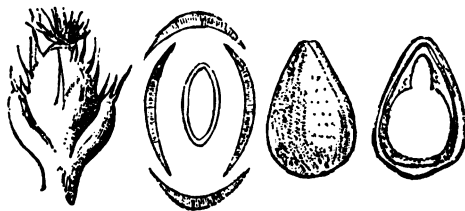


FIG. 394.

FIG. 395.

FIG. 396.

FIG. 397.

FIG. 392.—Male flower. Magnified.

FIG. 393.—Diagram of male flower.

FIG. 394.—Female flower. Magnified.

FIG. 395.—Diagram of female flower.

FIG. 396.—Seed. Magnified.

FIG. 397.—Section of seed. Magnified.

shrubs, found mostly in the mountains of Southern Asia. The Oleaster (*Eleagnus hortensis*) of Southern Europe is there much planted for its odoriferous flowers; it is occasionally planted in this country.

*Shepherdia Canadensis*, of the Northeastern United States, and *S. argentea*, the Buffalo-Berry of the Rocky Mountains and the Great Plains, are frequently cultivated for their acid fruits, which are about as large as currants.

**Order Hernandiææ**, including a few tropical trees.

FIGS. 398-402.—ILLUSTRATIONS OF *LAURUS NOBILIS*.

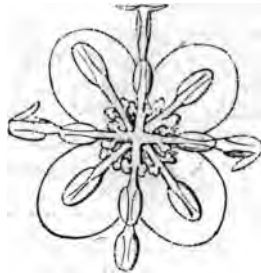


FIG. 398.

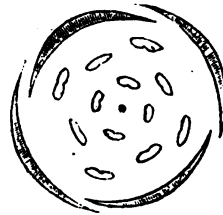


FIG. 399.

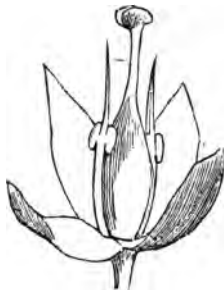


FIG. 400.



FIG. 401.



FIG. 402.

Fig. 398.—Male flower. Magnified.

Fig. 400.—Female flower. Magnified.

Fig. 402.—Diagram of female flower.

Fig. 399.—Diagram of male flower.

Fig. 401.—Section of female flower.

**Order Thymelæaceæ**.—Shrubby plants, mostly of the Southern Hemisphere. Of the 378 species we have in the United States but one representative, viz., the Moose-wood or "Wicopy" (*Dirca palustris*), a small shrub with exceedingly tough bark.

*Daphne Mezereum*, a poisonous shrub of Europe, is frequently cultivated here for its sweet-smelling flowers.

The bark of many species is used in their native countries for making

fabrics, cordage, etc. *Lagetta lintearia*, of Jamaica, is the Lace-Bark Tree, so called on account of its delicate inner bark.

578.—Cohort X. **Laurales.**—Herbs, shrubs, and trees, with mostly diclinous flowers; ovary superior, one-celled, the single seed sometimes with, and sometimes without endosperm.

**Order Lauraceæ.**—The Laurel Family. Aromatic trees and shrubs

FIGS. 403-5.—ILLUSTRATIONS OF MYRISTICA FRAGRANS.

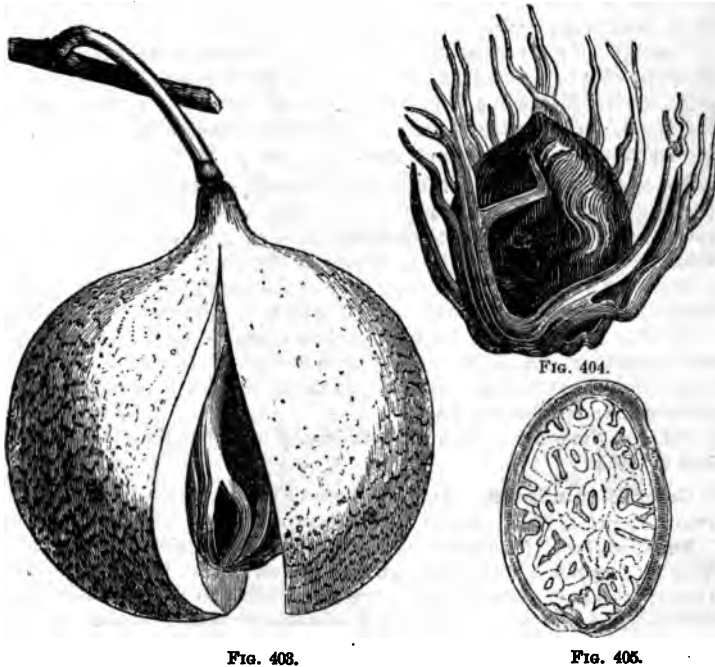


Fig. 403.—Fruit, showing seed and aril. Fig. 404.—Seed and aril.  
Fig. 405.—Seed cut vertically, showing embryo below.

(rarely parasitic herbs) with free stamens, and a pendulous seed without endosperm. About 1000 species are known, occurring in the tropical and temperate climates of both hemispheres.

*Laurus nobilis*, the Bay or Laurel of Southern Europe, is a fine spreading-topped evergreen tree, twelve to fifteen metres (40 to 50 ft.) high. In ancient times its leaves were used to crown heroes, but now

they are made use of in flavoring custards, puddings, etc., and are put into boxes of figs to give them a factitious flavor. (Figs. 398-402.)

*Umbellularia Californica* (*Tetranthera Californica*), the California Laurel, resembles the preceding, and like it is evergreen. Its wood is used in cabinet-making.

*Persea gratissima*, a small West Indian tree, produces a delicious fruit called Avocado- or Alligator-Pear.

Among the aromatic products are Cinnamon, the bark of *Cinnamomum Zeylanicum*, a small tree of Ceylon; Cassia Bark and Cassia buds, from *C. Cassia*, of Ceylon; Camphor, a gummy matter distilled from the wood of *C. Camphora*, a tree of China and Japan; Sassafras Bark, from *Sassafras officinale*, of the Eastern United States.

The wood of the two last-named trees is valuable in cabinet-making, as is also that of the Red Bay (*Persea*) of the Southern United States.

*Nectandra Rodiei*, the Greenheart Tree of Guiana, is a large tree furnishing an exceedingly heavy, dark colored, and durable timber, highly valued in naval constructions.

**Order Myristicaceæ.**—The Nutmeg Family. Aromatic trees, with monadelphous stamens, and an erect seed containing endosperm. The seventy-five species are all tropical, and most of them occur in the Indian region. They all belong to the genus *Myristica*.

*Myristica fragrans*, the Nutmeg Tree of the Malay Archipelago, attains a height of six to nine metres (20 to 30 ft.); it bears a fleshy fruit of the size of a walnut and inside of this is a large seed covered with a red, branching aril (Figs. 403-4). The seed, deprived of its integuments, is the nutmeg of commerce, while the dried aril is the Mace, both well known condiments.

Some of the other species are occasionally used, but they are much less valuable.

**Order Monimiaceæ.**—Aromatic trees or shrubs of the tropics and south temperate zone. About 150 species are known. The Tasmanian "Sassafras Tree" (*Atherosperma moschata*), the Australian "Sassafras Tree" (*Doryphora Sassafras*), and the New Zealand "Sassafras" (*Laurelia Novæ Zelandiæ*), are large trees thirty to forty-five metres (100 to 150 ft.) high, whose timber is valuable for ship-building.

**579.—Cohort XI. Chenopodiales.** Monoclinous (rarely diclinous) herbs or shrubs; ovary superior, one-celled, the single seed containing endosperm.

**Order Paronychiææ.**—A small group of mostly herbaceous plants, the flowers generally with both sepals and petals; the latter, however, rudimentary. The order has close affinities with Caryophyllaceæ, of which it should probably be considered a sub-order.

**Order Basellaceæ.**—Herbaceous, often climbing plants of the tropics. One species from South America (*Boussingaultia baselloides*)

is cultivated as an ornamental climber under the name of Madeira Vine. The starchy tubers of another species, *U. lucus tuberosus*, are used in Peru as substitutes for the potato.

**Order Chenopodiaceæ.**—Herbs, shrubs, or rarely trees, whose flowers have an herbaceous perianth. About 500 species, distributed in all climates, are known. (Figs. 406–11.)

*Beta vulgaris*, the Common Beet, is a native of Southern Europe. The Sugar Beet and Mangel Wurzel are only varieties of the Common Beet; the first is extensively cultivated in France for the sugar which

FIGS. 406-10.—ILLUSTRATIONS OF *BETA VULGARIS*.

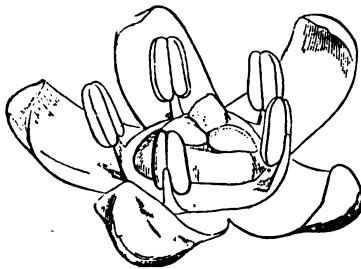


Fig. 406.

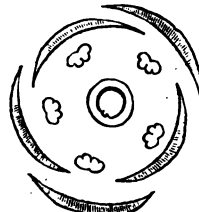


Fig. 407.

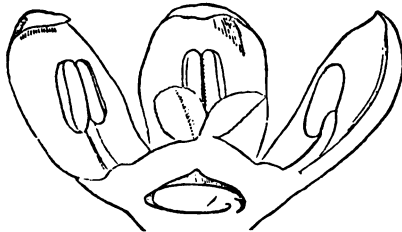


Fig. 408.

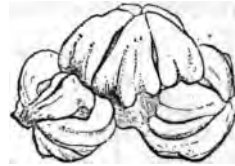


Fig. 409.



Fig. 410.

Fig. 406.—Flower. Magnified.

Fig. 408.—Section of flower. Magnified.

Fig. 410.—Seed. Magnified.

Fig. 407.—Diagram of flower.

Fig. 409.—Three fruits. Magnified.

is obtained from its sweet juice; its cultivation in this country is yet in its infancy.

*Chenopodium Quinoa*, a Peruvian annual, is cultivated in Western South America for its nutritious seeds, which are ground into meal, and used as an article of food.

*C. ambrosioides*, Wormseed, from tropical America, used somewhat in medicine, and other species of the genus, have become common weeds in fields and gardens.

*Spinacia oleracea*, Common Garden Spinach, is an Oriental plant much cultivated as a pot herb.

**Order Amarantaceæ.**—Herbs, rarely shrubs, whose flowers have a scarious perianth. The order, which contains about 500 species, is mostly tropical, a few occurring in temperate climates, but none at all in cold ones.

In India some of the species are cultivated for their starchy seeds, which are used for food.

Several species are cultivated with us for their ornamental foliage, (*Achyranthes*) or their colored inflorescence, e.g., Cock's Comb (*Celosia*), Globe Amaranth (*Gomphrena*), etc.



Fig. 411.—Section of seed of *Chenopodium*. Magnified.

*Amarantus retroflexus* and *A. albus*, are common weeds in fields; the latter, in the prairie region, grows in a globular form, and in the autumn breaks off at the root, and is blown for miles across the country. On account of this habit of growth it is called the "Tumble Weed."

**Order Polygonaceæ.**—The Buckwheat Family. Herbs, shrubs, or rarely trees, mostly with sheathing stipules and knotted-jointed stems; perianth often petaloid. The 600 species constituting the order are mostly natives of temperate regions.

*Fagopyrum esculentum*, Buckwheat, a native of Central or Northern

FIGS. 412-15.—ILLUSTRATIONS OF FAGOPYRUM ESCULENTUM.

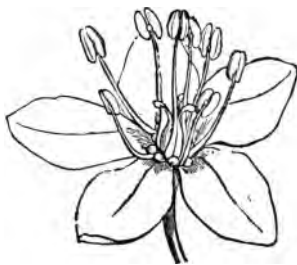


FIG. 412.

Fig. 412.—Flower. Magnified.



FIG. 413.

Fig. 413.—Diagram of flower.



FIG. 414.



FIG. 415.

Fig. 415.—Fruit. Magnified.

Asia, is now extensively grown in Europe and America for its nutritious seeds, and for its honey-producing flowers. (Figs. 412-15.)

*Polygonum amphibium*, var. *terrestre*, a native of the United States, has been used in the Mississippi valley as a substitute for bark in the process of tanning. It contains a considerable quantity of tannin.

*Rheum officinale*, Oriental Rhubarb, is a native of Southeastern Asia; its roots constitute the officinal Rhubarb. Other species are often used as substitutes.

*R. Rhaponticum*, a native of Western Asia, is commonly grown in gardens under the name of "Pie Plant," its petioles are used for the pleasant acid they contain.

Many species are weeds of fields and gardens; such are Smartweed, and Black Bindweed (*Polygonum*, sp.), Docks and Sorrel (*Rumex*, sp.).

**Order Phytolaccaceæ.**—Mostly tropical herbs, sometimes shrubs or trees, usually with several free or united carpels. About eighty species are known, most of which are more or less acid.

*Phytolacca decandra*, the Common Pokeweed, is our most notable representative. It is, however, a doubtful native.

**Order Nyctaginaceæ.**—Mostly tropical herbs, shrubs, or trees with opposite leaves and tumid joints; flowers gamophyllous. About 200 species are known. The roots of many of the species are purgative or emetic.

*Abronia*, of several species. *Mirabilis*, sp., the Four O'clock, or Marvel of Peru, and some others, are cultivated as ornaments.

II. GAMOPETALÆ.—Plants whose flowers generally have both sepals and petals, the latter connately united.

**580.—Cohort XII. Lamiales.** Plants with zygomorphic flowers, superior ovaries, indehiscent fruits, with the seeds solitary in the two to four cells.

**Order Labiatæ.**—The Mint Family. Aromatic herbs or shrubs, with four-angled stems and opposite leaves. The species, of which there are about 2500, are abundant in temperate and warm climates, but are rare in cool regions. We have about 200 native species in North America. (Figs. 416-18.)

Considering the size of the order, it ranks low from an economic standpoint. The aromatic herbage has led to the use of many species as domestic remedies, few of which, however, are really valuable. Nevertheless, there are many species yielding minor products which are of some value.

*Hyssopus officinalis*, Hyssop, a small shrub of Southern Europe, is commonly cultivated in gardens as a domestic medicine.

*Hedeoma pulegioides*, American Pennyroyal, is an officinal herb.

*Lavandula vera*, Lavender, is a shrubby plant of the South of Europe, cultivated in gardens, and used as a domestic perfume. Oil of Lavender is obtained from it by distillation.

*Mentha piperita*, Peppermint, introduced from Europe, yields Oil of Peppermint by distillation. It is extensively grown in Southern Michigan and New York.

*Marrubium vulgare*, White Horehound, of Europe, is commonly found in gardens; its dried herbage is officinal.

*Rosmarinus officinalis*, Rosemary, *Thymus vulgaris*, Thyme, and *Sal-*



*via officinalis*, Garden Sage, are small South European shrubs, now to be found in all gardens.

Catnip, Balm, Horsemint, and many others are used more or less as family medicines, for which purpose they are well suited, being harmless and feebly operative.

Several tropical species of *Salvia* are grown as ornaments, as are also *Coleus* and *Perilla*, from Southeastern Asia.

**Order Verbenaceæ.**—The Vervain Family. Herbs, shrubs, or trees, usually not aromatic, with mostly four-angled stems. The species number about 700, and are chiefly tropical. They generally possess a bitter and astringent principle.

With us the order is esteemed principally for its ornamental value.

FIGS. 416-18.—ILLUSTRATIONS OF LABIATÆ.

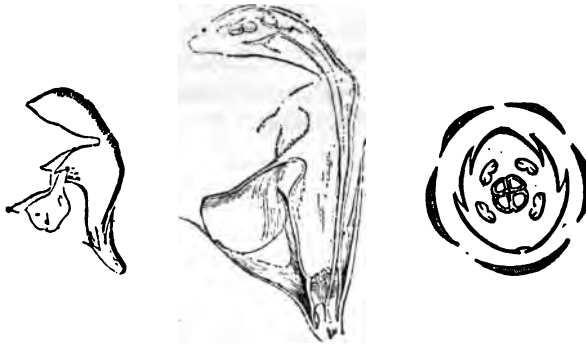


FIG. 416.

FIG. 417.

FIG. 418.

Fig. 416.—Flower of *Lantana*, side view.

Fig. 417.—Vertical section of flower. Magnified.

Fig. 418.—Diagram of flower.

Besides the several South American species of *Verbena* in common cultivation, the so-called Lemon Verbena (*Lippia citroidora*) from Chili, and the species of *Lantana* from tropical America, there are to be found in conservatories many showy species of *Clerodendron*, from Asia.

*Tectona grandis*, the Teak Tree of India, is a gigantic tree whose yellowish durable wood is much used in ship-building. It is said to resist the attacks of *Limnoria terebrans* when exposed in sea-water.

*Vitex littoralis*, of New Zealand, and other species, growing in the Indo-Australian region, are large and valuable timber trees.

**Order Myoporinæ.**—Mostly Australian shrubs, of no value.

**581.—Cohort XIII. Personales.** Plants with zygomorphic flowers, superior ovaries, and dehiscent many-seeded fruits.

**Order Acanthaceæ.**—The Acanthus Family. Herbs, mostly of the tropics, numbering about 1500 species. Thirty-five or forty species occur in North America, mostly, however, in the South and West. Some of the exotic species are grown in conservatories, *e.g.*, *Justicia*, *Thunbergia*, etc.

**Order Pedaliaceæ.**—Herbs with glandular hairs. The most important species are the Asiatic *Sesamum Indicum* and *S. orientale*, whose seeds yield an oil much used as food by the inhabitants of the tropics.

*Martynia proboscidea*, the Unicorn Plant of the Southwestern United States, is notable for its two-hooked fruits.

**Order Bignoniaceæ.**—Mostly woody plants, numbering about 500 species, and natives, for the most part, of the tropics. Many are cul-

FIGS. 419-22.—ILLUSTRATIONS OF SCROPHULARIACEÆ (*Scrophularia*, sp.).

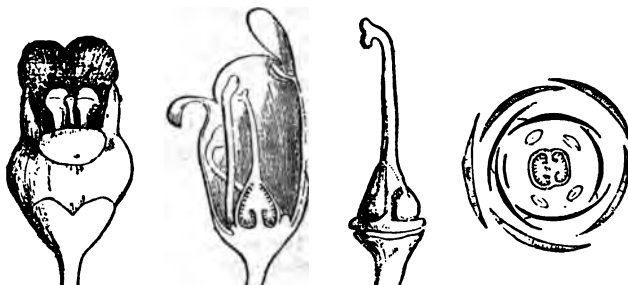


FIG. 419.

FIG. 420.

FIG. 421.

FIG. 422.

Fig. 419.—Flower. Magnified.

Fig. 421.—Pistil. Magnified.

Fig. 420.—Section of flower.

Fig. 422.—Diagram of flower.

tivated for their fine flowers among these are the species of *Bignonia*; *Tecoma*, etc.

*Catalpa bignonioides*, the Common Catalpa of the Southern United States, is a fine tree for shade and ornament. Its wood is said to be very durable. *C. speciosa* is much hardier than the preceding.

*Crescentia Cujete*, the Calabash Tree of tropical America, produces a large pulpy fruit whose hard rind is used as a water-vessel.

**Order Gesneraceæ.**—Mostly tropical plants, represented by *Achimenes*, *Gloxinia*, *Gesnera*, etc., cultivated in conservatories.

**Order Columelliaceæ.**—Evergreen trees or shrubs of tropical America.

**Order Lentibulariaceæ.**—The Bladderwort Family. Mostly aquatic or marsh plants, of temperate and cold regions, interesting on account of the insect-catching bladders of the aquatic species. (For

the particulars as to *Pinguicula*, see Darwin's "*Insectivorous Plants*," pp. 368-394, and for *Utricularia*, pp. 395-444.)

**Order Orobanchaceæ.**—Leafless parasitic herbs, numbering 150 species, widely distributed. We have about a dozen native species in the United States.

**Order Scrophulariaceæ.**—The Figwort Family. Herbs or shrubs, rarely trees, with two-celled ovaries and central placentæ. The species, of which there are about 2000, are found in all parts of the world, extending in both hemispheres to the limits of vegetation. Many of the species contain an acrid poisonous principle. (Figs. 419-22.)

*Digitalis purpurea*, the Foxglove, a small plant of Europe, affords the drug *Digitalis*, which is officinal.

Many species are cultivated for their fine flowers; among these are the Snapdragon (*Antirrhinum*), Monkey Flower (*Mimulus*), *Maurandia*, *Pentstemon*, *Veronica*, *Calceolaria*, etc., etc.

*Paulownia imperialis*, a small tree of Japan, is planted in the Southern States.

*Verbascum Thapsus*, the Common Mullein, is a weed introduced from Europe.

**582.—Cohort XIV. Polemoniales.** Plants with alternate leaves, regular flowers, stamens isomerous with the corolla lobes, and ovary superior.

**Order Solanaceæ.**—The Nightshade Family. Herbaceous or woody plants with a watery juice; ovary two-celled, many ovuled. This large order of from 1200 to 1500 species, which are chiefly tropical, is pervaded by a more or less poisonous principle. (Figs. 423-7.)

There are, however, a few valuable food plants.

*Solanum tuberosum*, the Potato, is a native of America from Mexico to Chili, and a variety of it (var. *boreale*) even occurs in New Mexico. The potato was introduced into Spain in the early part of the sixteenth century, and into England by Sir Walter Raleigh in 1586, but for nearly a century from the latter date it was little used. It is now, however, grown extensively in nearly all countries. In its wild state its tubers are not more than two to three centimetres in diameter, but by culture and selection they have been increased fifteen to twenty times in bulk.

*Solanum Melongena*, the Egg Plant, of South America, is now grown with us for its egg-shaped edible fruits.

*Lycopersicum esculentum*, the Tomato, of South America, is grown in most warm and temperate countries for its wholesome fruits.

*Physalis Alkekengi*, the Winter Cherry or Strawberry Tomato, of the South of Europe, is grown in our gardens for its edible fruit, which is enclosed in the inflated calyx. Our native species of this genus, called commonly Ground Cherries, are valuable for food.

*Capsicum annuum*, of South America, and other species of the genus,

FIGS. 423-7.—ILLUSTRATIONS OF SOLANACEÆ.



FIG. 423.—Flowering stem of Potato.  
 FIG. 424.—Flower of Bittersweet. Magnified.  
 FIG. 425.—Diagram of Potato flower.  
 FIG. 426.—Calyx and pistil of Potato. Magnified.  
 FIG. 427.—Section of seed of Bittersweet. Magnified.

bear exceedingly pungent pods, known as Peppers. The ground pods constitute the Cayenne Pepper of commerce.

*Atropa Belladonna*, the Deadly Nightshade, *Hyoscyamus niger*, Henbane, and *Datura Stramonium*, the Thorn Apple, all of the Old World, supply powerful narcotic medicines. That from the first, under the name of Belladonna, is much used by oculists to dilate the pupil of the eye.

*Nicotiana Tabacum*, Tobacco, a South American herb, was cultivated by the American aborigines long before the advent of Europeans. It was taken to Spain about the beginning of the sixteenth century, and to England from sixty to eighty years later. It is now extensively cultivated in many countries, especially in the United States, and is used by all the civilized nations of the globe. Two or three other species are also cultivated in different parts of the world.

Among the ornamental plants of the order are species of *Cestrum* and *Datura*, from South America and Mexico; *Lycium*, from Europe; *Petunia*, from South America, etc., etc.

The Thorn Apple mentioned above, and the Black Nightshade (*Solanum nigrum*) are common as weeds. The little black berries of the latter are made into pies and other pastry in the Mississippi Valley.

**Order Convolvulaceæ.**—Herbaceous climbers, rarely shrubs, often with a milky juice; ovary two-celled, one to two, rarely four-ovuled. About 800 species are known, distributed mostly in tropical and warm temperate regions. They generally possess an acrid principle.

The Common Morning-Glory (*Ipomœa purpurea*) and one or two near relatives, all from tropical America, are familiar ornamental climbers.

*Ipomœa Batatas*, the Sweet Potato of India, has long been cultivated in many warm and temperate climates for its nutritious roots.

The purgative drug Jalap is derived from the root of a Mexican plant *Ipomœa purga*.

*Convolvulus Scammonia*, of Western Asia, yields the drug Scammony, and from the wood of *C. Scoparius*, a shrubby species of the Canary Islands, Oil of Rhodium is extracted.

*Cuscuta*, the parasitic Dodder, includes many species.

**Order Boraginaceæ.**—The Borage Family. Usually hispid herbs, shrubs, or trees, with a four-parted ovary, each part one-ovuled. The 1200 species are distributed throughout the world, although they are most numerous in Southern Europe and Western and Central Asia. Many of the species possess a mucilaginous property useful in making cooling drinks, and the roots of some contain purple or brown dyes.

*Anchusa tinctoria*, of the South of Europe, is grown in France and Germany for its roots, which yield the red dye called Alkanet.

Among the commonly cultivated ornamental plants may be mentioned the Forget-me-not (*Myosotis palustris*) of Europe and the Heliotrope (*Heliotropium Peruvianum*) of Peru. There are several native and introduced species which are vile weeds.

**Order Hydrophyllaceæ.**—A small order of mostly American herbs, closely related to the preceding.

Species of *Nemophila*, *Phacelia*, *Whitlavia*, etc., are cultivated in flower gardens.

**Order Polemoniaceæ.**—Mostly herbs of North America and Northern Asia, numbering about 150 species.

Species of *Phlox*, *Gilia*, *Polemonium*, *Cobaea*, etc., are cultivated in flower gardens.

**583.—Cohort XV. Gentianales.** Plants with opposite leaves, regular flowers, superior ovary, and the stamens usually as many as the corolla lobes and alternate with them.

**Order Gentianaceæ.**—The Gentian Family. Annual or perennial herbs, with a watery juice; ovary generally one-celled, with many ovules. The species, of which there are about 500, are found mostly in temperate and cold climates. They possess a bitter principle, which has been employed in medicine. We have many very pretty wild species.

**Order Loganiaceæ.**—Woody plants almost entirely of the tropics, with two-celled ovaries. About 350 species are known; they contain a bitter principle which is often exceedingly poisonous.

*Strychnos nux-vomica* is a small tree of India, bearing an orange-like fruit containing numerous large flattish seeds (2 cm. in diameter). These seeds constitute the poisonous drug, Nux Vomica; they contain two alkaloids to which their activity is due, viz, Strychnia ( $C_{21}H_{22}N_2O_4$ ) and Brucia ( $C_{23}H_{26}N_2O_4 + 4H_2O$ ). The ordinary form of the first as found in the shops is a Sulphate of Strychnia.

*S. toxifera*, a tree of the northern parts of South America, yields from its bark and young wood the famous poison known as Curare, Urari, Ourari, Woorara, etc.

*S. Tieute*, a Javanese climber, furnishes the virulent Upas Tienté or Tjettek with which the natives poison their arrows.

**Order Asclepiadaceæ.**—The Milkweed Family. Woody or herbaceous plants, with a milky juice; ovaries two, distinct, but with a single common stigma; pollen agglutinated into masses (pollinia). This large order of about 1300 species is chiefly tropical, being abundantly represented in America, Africa, and Asia. The milky juice contains Caoutchouc, and usually acrid and poisonous principles. But few of the species are of sufficient economic importance to demand notice. Many have a local reputation as domestic medicines. (Figs. 428-32.)

Some are favorites in the flower garden or conservatory, e.g., the Wax Plant of India (*Hoya carnosa*), species of *Ceropegia*, *Stephanotis*, *Periploca*, etc. The South African Stapelias resemble *Cacti*, being fleshy and leafless.

The peculiar structure of the flowers in this order has recently been shown to be for the purpose of securing the services of insects in the process of pollination.

**Order Apocynaceæ.**—The Dogbane Family. Woody or herbaceous plants, generally with a milky juice; ovaries two, distinct or cohering, the style always single; pollen granular. In this order of about 900 species there is very generally present a drastic purgative or poisonous principle. Most of the species are tropical, a few only extending into temperate climates.

The milky juice of several species produces Caoutchouc when evaporated, and that from a few species of *Couma*, *Tabernaemontana*, etc., in northern South America is used for food.

*Tanghinia venenifera*, a tree of Madagascar, produces a fruit whose seed is the exceedingly virulent Ordeal Poison or Tanghin.

Some of the trees of the order furnish timber, which is of considerable local value.

Our native species of *Apocynum* (viz., *A. cannabinum* and *A. androsæmifolium*) possess a tough fibrous bark which was used by the Indians for making cordage, nets, etc.

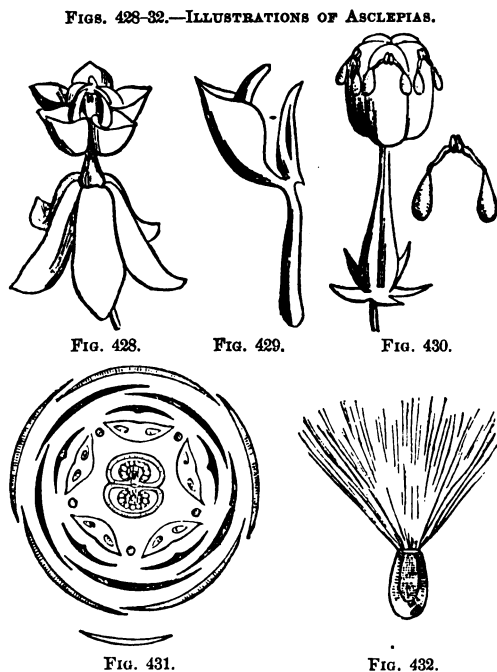


FIG. 428.—Flower, with perianth reflexed. Magnified.  
FIG. 429.—Stamen, with its hood. Magnified.  
FIG. 430.—Gynoecium with pollen-masses adhering to the stigma; two separated pollen-masses at the side. Magnified.  
FIG. 431.—Diagram of flower.  
FIG. 432.—Seed. Magnified.

Among the cultivated plants are *Nerium Oleander*, the Oleander from the Levant, an evergreen shrub or small tree with poisonous wood, bark and foliage; *Vinca*, sp. Periwinkle or, as it is erroneously called, Trailing Myrtle; *Echites*, *Allamanda*, etc.

**Order Salvadoraceæ.**—A few shrubs of the Old World tropics.

**Order Oleaceæ.**—The Olive Family. Woody or rarely herbaceous

plants ovaries two-celled, each cell with one to three ovules; stamens two. The species, 280 in number, are distributed widely over temperate and tropical regions.

*Olea Europea*, the Olive, probably a native of Western Asia, is now extensively cultivated in all warm temperate climates. It is a small evergreen tree, and produces a bluish oily drupe, from which by pressure Olive Oil or Sweet Oil is obtained. The wood of the Olive Tree is very hard and is used in turnery and cabinet-making.

*Fraxinus excelsior*, the Ash Tree of Europe and North Africa, is a large tree, yielding a white, hard, tough and elastic timber, highly prized in the manufacture of implements, in turnery, coach-making, etc. The tree is frequently planted in the United States.

*F. Americana*, The American White Ash of the Eastern United States, is larger than the preceding, attaining frequently a height of thirty metres (100 feet) or more. Its timber resembles that of the Ash of Europe, but is even more valuable.

*F. Oregona*, of Oregon and Northern California, furnishes a timber much like that of the White Ash.

*F. sambucifolia*, the Black Ash of the Northeastern United States, is a large tree usually found in moist situations; the annual layers of its wood easily separate into thin strips admirably suited to make into barrel hoops, baskets, etc. Other native species also supply more or less valuable timber.

In Jamaica a species of *Linociera* produces a very hard, fragrant and excellent timber known as Jamaica Rosewood. A species of *Notelaea*, in Australia and Tasmania, yields a hard timber called Iron-wood, much used in making ship-blocks, and for other purposes where hardness is required. Several genera afford ornamental plants, e.g., *Jasminum*, of many species, Jessamine; *Syringa*, the Lilac; *Ligustrum*, the Privet; *Chionanthus*, the Fringe Tree; *Forsythia*, etc.

**584.—Cohort XVI. Ebenales.**—Shrubs or trees with alternate leaves, regular flowers, and superior ovary; ovules usually solitary in the two to many cells; stamens generally alternate with the corolla lobes.

**Order Styracaceæ.**—Plants with a watery juice and monoclincous flowers. There are about 220 species in the order, found almost entirely in the tropical parts of America, Asia, and Australia.

*Styrax officinale*, of the Levant, yields from incisions in the bark Gum Storax, and from *S. benzoin* of the Malay Islands, Gum Benzoin is similarly obtained.

A few species afford dyes, but none are widely used.

*Halenia tetraptera*, the Silver-Bell or Snow-Drop Tree of the Southern United States, is a highly ornamental shrub.

**Order Ebenaceæ.**—The Ebony Family. Plants with a watery



juice, and mostly diclinous flowers. About 250 species are known in this order, the greater part occurring within the tropics.

*Diospyros reticulata*, a large tree of the island of Mauritius, produces the best of the timber known as Ebony. Ebony is also derived from *D. Ebenum* and *D. melanoxylon* of Ceylon, and *D. Ebenaster* of the Calcutta region.

*D. hirsuta*, of Ceylon, produces the beautiful "Calamander Wood," which is variegated with brown and yellow stripes.

*D. Kaki*, a Chinese and Japanese tree, bears plum-like fruits which are delicious. In our markets they are known as Chinese Dates.

*D. Virginiana*, the Persimmon of the Southern United States, produces fruits similar to the last, but astringent and inedible until after being frosted. Doubtless under culture this fruit might be made to equal the preceding.

**Order Sapotacæ.**—Plants with a milky juice and monoclinous flowers. A tropical order of about 300 species, a few of which extend into temperate regions.

*Isanandra gutta*, a large tree of the Malay Islands and Borneo, is the source of the Gutta Percha of commerce. The milky juice is collected and evaporated, and then constitutes the crude Gutta Percha.

*Chrysophyllum Cainito*, the Star Apple, *Archas sapota*, the Sapodilla Plum, and *Archas mammosa*, the Marmalade, are West Indian trees, which bear delicious pulpy fruits.

*Bassia butyracea* and *B. latifolia*, both of India, and *B. Parkii*, of tropical Africa, are called Butter Trees, on account of the butter-like fatty substance obtained from their seeds by pressure.

We have eight species within the United States, found mostly along our Southern coast. Two species of *Bumelia* reach the Ohio River.

**585.—Cohort XVII. Primulales.**—Plants with mostly alternate leaves, regular flowers, and superior one-celled ovaries; stamens generally opposite to the corolla lobes.

**Order Myrsinacæ.**—Trees or shrubs, mostly of the tropics. Three or four species barely reach the southern part of Florida.

**Order Primulacæ.**—The Primrose Family. Herbs mostly with radical leaves; placenta central, free and globose; ovules many, fixed by their ventral face. Species 250, mostly of the North Temperate Zone. (Figs. 433-5.)

The order is chiefly valuable for its ornamental plants.

*Primula vulgaris*, the Primrose, and *P. veris*, the Cowslip, are common English plants, often referred to in poetry.

*P. Sinensis*, the Chinese Primrose, and *P. Auricula*, the Auricula from Southern Europe, are common in gardens and green-houses.

*Cyclamen*, *Dodecatheon*, and *Lysimachia* contain fine ornamental species.

*Anagallis arvensis* is a little weed from Europe.

**Order Plantaginaceæ.**—The Plantain Family. Herbs, mostly with radical leaves ; placenta central, not free ; ovules usually many, fixed by their ventral face. This anomalous order appears to be more at home in this Cohort than anywhere else. It disagrees with the characters given for the Cohort in its ovary being for the most part two-celled.

FIGS. 433-5.—ILLUSTRATIONS OF ANAGALLIS ARVENSIS.

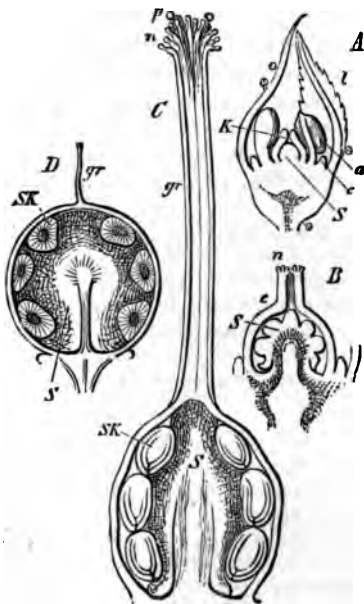


FIG. 433.



FIG. 434.



FIG. 435.

Fig. 433.—Section of young flower-bud. *l*, calyx ; *c*, corolla ; *a*, stamens ; *K*, pistil ; *S*, placenta. *B*, gynæcium further advanced. *C*, gynæcium ready for fertilization. *D*, young fruit. (After Sachs.)

Fig. 434.—Ripe fruit. Magnified.

Fig. 435.—Dehiscent fruit. Magnified. *g*, seeds.

Otherwise its agreement is so marked as to allow us to regard it as a group of degraded Primulales. The species number about fifty, and are found in all temperate regions.

*Plantago major*, the common Plantain, is found everywhere in door-yards.

**Order Plumbaginaceæ.**—Herbs or barely woody plants, with leaves radical or cauline ; ovary one-celled, one-ovuled. About 200 species are known, distributed throughout temperate climates.

*Armeria vulgaris*, Thrift, of Europe, is cultivated in flower-gardens.  
*Plumbago*; several South African and East Indian species, are to be met with in conservatories.

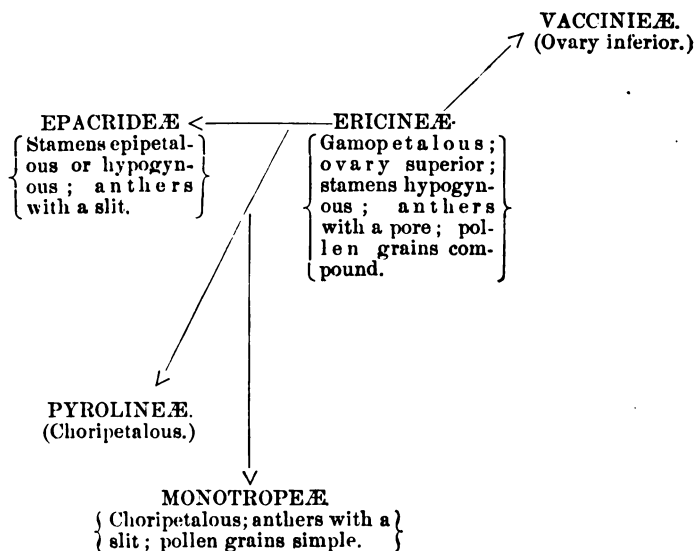
586.—Cohort XVIII. **Ericales**.—Plants with regular flowers, and superior two to many-celled ovaries; stamens as many or twice as many as the corolla lobes, hypogynous or epipetalous.

**Order Lennoaceæ**.—Californian and Mexican leafless root-parasites.

**Order Diapensiaceæ**.—Low plants (six to eight species) of North America and Eastern Asia, of much botanical, but no economic interest.

**Order Ericaceæ**.—The Heath Family. Mostly shrubs or small trees, a few herbs, with usually alternate, simple, and entire leaves; ovary mostly five-celled, with placentæ in the axis; anthers opening by a terminal pore, rarely by a lateral slit; pollen grains compound, rarely simple.

Under these characters are included about 1700 species, which are often regarded as constituting five orders, viz., *Ericineæ*, *Epacrideæ*, *Pyrolineæ*, *Monotropeæ*, and *Vaccinieæ*, here to be considered as sub-orders. While, however, there are considerable differences between the plants here brought together, they are not important enough to counterbalance the many evident resemblances. The relationship subsisting between the sub-orders may be shown as follows:



The Ericineæ are doubtless to be regarded as the central or main group, from which the others have diverged. In the diagram the distinguishing characters which are given for Ericineæ may be regarded as typical for the order, and under each of the other sub-orders are given the exceptional characters, or more properly, the modifications of the original ordinal characters.

**Sub-Order Ericineæ.**—About 1000 species of shrubs, many evergreen. Many are of great beauty, and are extensively grown as ornaments; others are good-sized trees, and furnish valuable timber. (Figs. 436-9.)

*Arbutus Menziesii*, the Madroña of the Pacific coast of the United States, is an evergreen tree twenty-four to thirty metres (80 to 100 ft.) in height. Its hard wood is useful in furniture-making.

*Arctostaphylos pungens* and *A. glauca* are large evergreen shrubs of California, which bear the name of Manzanita. The heavy, dark-colored, and fine-grained wood is used in turnery and furniture-making. The berries are eaten by grizzly bears.

*A. Uva-ursi*, the Bearberry of the colder portions of North America, Europe, and Asia, bears bitter and astringent leaves, which are officinal.

*Calluna vulgaris*, the Common Heath of Central and Northern Europe, is a low, straggling evergreen under-shrub. Its stems are made into brooms, and its flowers afford an abundance of excellent honey. It occurs in a few scattered localities in Massachusetts, Maine, Nova Scotia, and northward, but it is doubtful whether it is really indigenous to any part of the United States.

FIGS. 436-9.—ILLUSTRATIONS OF ERICA CINEREA.

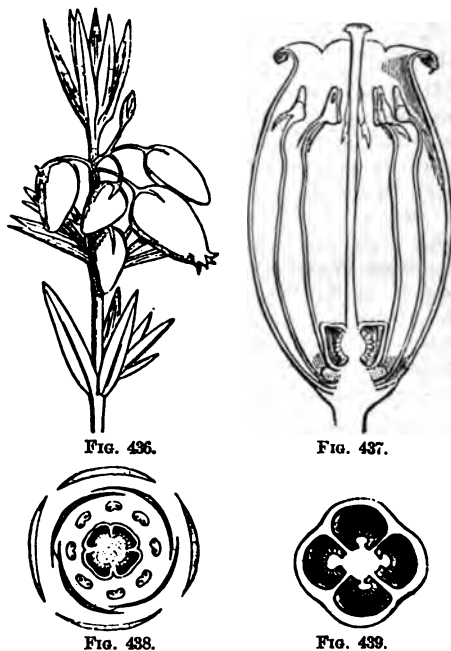


Fig. 436.—Flowering stem.  
Fig. 437.—Section of flower. Magnified.  
Fig. 438.—Diagram of flower.  
Fig. 439.—Section of ovary. Magnified.

*Epigæa repens*, the Mayflower or Trailing Arbutus, is a low trailing plant with a woody stem, found chiefly in New England and adjacent regions. Its rose-colored fragrant flowers, which appear in early spring, are much sought for.

*Erica*. This large genus, including 400 or more species, is distributed in Europe, Northern Asia, and Northern and Southern Africa, reaching its maximum in the latter region. None are found in America. Many species are grown in conservatories.

*Gaultheria procumbens*, Wintergreen or Checkerberry, has aromatic fruit and foliage. From the latter an official oil is distilled.

*Kalmia*. A genus of beautiful plants with curious flowers; each stamen when the flower opens is bent backward, and its anther is hidden in a sac in the corolla; somewhat later the anthers escape from the sacs and the pollen is ejected. This mechanism has probably to do with the process of cross-fertilization through the agency of insects. Some of our native species are reputed to be poisonous to domestic animals, e.g., *K. angustifolia*, the Sheep Laurel or Lambkill.

*Rhododendron*. This genus is now made to include the Azaleas as well as the true Rhododendrons. Some species become large trees (*R. arboreum* of the Himalayas), while many are highly prized as ornamental shrubs. The Great Laurel (*R. maximum*), a shrub or small tree, with large evergreen leathery leaves, grows in the Alleghany Mountains. *R. Catawbiense* and its hybrids with *R. arboreum* are extensively planted for ornaments. *R. Indica* is the Azalea of the florists; it has many varieties.

**Sub-Order Epacrideæ.**—About 320 species of shrubs or small trees, often with a Heath-like appearance; natives of Australia and many of the Pacific islands; only one species is found in South America. Many species are grown in conservatories, e.g., *Epacris*, *Leucopogon*, *Dracophyllum*, etc.

**Sub-Order Pyrolineæ.**—Perennial herbs, about twenty species, all of the North Temperate Zone. They are of but little account economically or otherwise. *Chimaphila maculata*, Pipsissewa or Prince's Pine, was used by the Indians as a medicine. The dried leaves constitute the official drug Chinaphila.

The anomalous genus *Cletra*, including twenty-five species of shrubs and trees (American and Asiatic) is sometimes placed in this sub-order on account of its choripetalous corolla; it appears, however, to properly fall into the Ericineæ, in either the tribe Andromedæ or Rhodoreæ.

**Sub-Order Monotropeæ.**—Small herbs, parasitic or saprophytic, destitute of chlorophyll; their leaves are reduced to mere bracts, and their flowers and seeds show still further degradation. Ten or twelve species are known, distributed throughout the temperate parts of the Northern Hemisphere.

*Monotropa uniflora*, Indian Pipe, is common throughout nearly all North America. It appears to be saprophytic.

*Sarcodes sanguinea* is the interesting Snow Plant, which in the Sierra Nevada Mountains of California shoots up its flesh-red stem and flowers in early spring, soon after the snow melts.

**Sub-Order Vaccinieæ.**—Shrubby plants, mostly of the Northern Hemisphere. Species, 320. The thick adherent calyx-tube of the flower often becomes fleshy and edible in fruit. (Figs. 440-441.)

*Gaylussacia resinosa*, a low shrub of the Eastern United States, produces the Black Huckleberries of the markets.

*Vaccinium Pennsylvanicum*, the Early Blueberry, or Blue Huckleberry, and *V. vacillans*, the Low or Late Blueberry, are common in the Northeastern United States.

*V. corymbosum*, the Swamp Blueberry, is also common in the Eastern United States. Be-

sides these, other species furnish edible fruits which are sometimes found in the markets. *V. Myrtillus* occurs with us only in the Rocky and Sierra Nevada Mountains.

*V. Oxyccoccus*, the Small Cranberry of the Northeastern United States, and the much larger *var. macrocarpon*, or Large Cranberry, which extends much further south,

are valuable for their acid fruits. The variety is extensively cultivated from Massachusetts to Wisconsin.

**587.—Cohort XIX. Campanales.** Plants with flowers mostly zygomorphic; ovary inferior, two- to six-celled (rarely one-celled); ovules usually many in each cell.

**Order Campanulaceæ.**—Herbs, rarely shrubs, usually with alternate leaves and a milky juice; ovary two- to many-celled. The 1000 species which compose this order were until recently divided between the two orders Lobeliaceæ and Campanulaceæ, which are here merged into one. The order as now constituted is represented in all regions, but most abundantly in temperate ones. All possess more or less acidity, which in some cases becomes a dangerous poison.

*Lobelia inflata* and *L. syphilitica* of the Eastern United States have been used in medicine; now principally used by quacks.

FIGS. 440-441.—ILLUSTRATIONS OF VACCINIUM MYRTILLUS.



FIG. 440.

Fig. 440.—Flower. Magnified.



FIG. 441.

Fig. 441.—Section of flower. Magnified.

*L. cardinalis*, the Cardinal Flower, of the Eastern United States, and several foreign species, are showy plants in the flower-garden.

*Campanula medium*, Canterbury Bells, and other European species, are in common cultivation.

**Order Goodeniaceæ.**—Mostly Australian, herbaceous plants, numbering about 200 species, of but little economic value.

**Order Stylidiaceæ.**—Curious herbs, about 100 in number, mostly Australian. Species of *Stylidium* are grown in conservatories.

**588.—Cohort XX. Asterales.** Plants with actinomorphic or zygomorphic flowers; stamens inserted on the corolla and isomerous with its lobes; ovary inferior, one-celled, one-ovuled (rarely two- to three-celled). Calyx limb often greatly reduced, forming a pappus, sometimes wanting.

**Order Compositæ.**—The Sunflower Family. Herbs, shrubs, or rarely trees; anthers united to each other; ovary, one-celled, containing a single erect seed destitute of endosperm. In this immense family of fully 10,000 species, distributed throughout all parts of the world, the small flowers are gathered into compact heads, which themselves often resemble single flowers. Many of the species are of great beauty, and are greatly admired as ornaments, but it is curious to observe, that despite the great size of the order, there are but few plants which are otherwise of any considerable use to man. Many are troublesome weeds.

In Bentham and Hooker's "Genera Plantarum," the 766 genera are arranged under thirteen tribes, as given below.

**Tribe 1. Cichoriaceæ.**—Flowers all ligulate; juice milky.

*Cichorium Intybus*, Chicory, of Europe, is much cultivated in France and Germany. Its roots are used to adulterate coffee. *C. Endivia*, of India, is the Endive, cultivated in gardens as a salad plant.

*Lactuca sativa*, the Garden Lettuce, is probably a native of Asia. The dried juice of *L. virosa*, of Europe, constitutes the narcotic drug Lactucarium.

*Taraxacum Dens-leonis*, the Common Dandelion, is used somewhat in medicine. (Figs. 442-5.)

*Tragopogon porrifolius*, Salsify, of Europe, is cultivated for its edible root.

**Tribe 2. Mutisiaceæ.**—Flowers usually bifid, *i.e.*, two-lipped. We have but one representative, *Chaptalia tomentosa*, in Southeastern United States. They abound in tropical America.

**Tribe 3. Cynaroideæ.**—Flowers all tubular.

*Cynara Scolymus*, a native of the Mediterranean basin, is the Artichoke, grown for the thick scales of its flower heads, which are edible.

*Carthamus tinctoria*, a Chinese annual, is grown in gardens for its

red flowers, which are gathered and dried, constituting the dye Safflower.

*Centaurea odorata* and *C. moschata*, from Asia, and other European and American species, are cultivated in flower gardens.

*Cnicus* includes our Thistles, most of which are weeds in fields.

FIGS 442-5.—ILLUSTRATIONS OF TARAXACUM DENS-LEONIS.

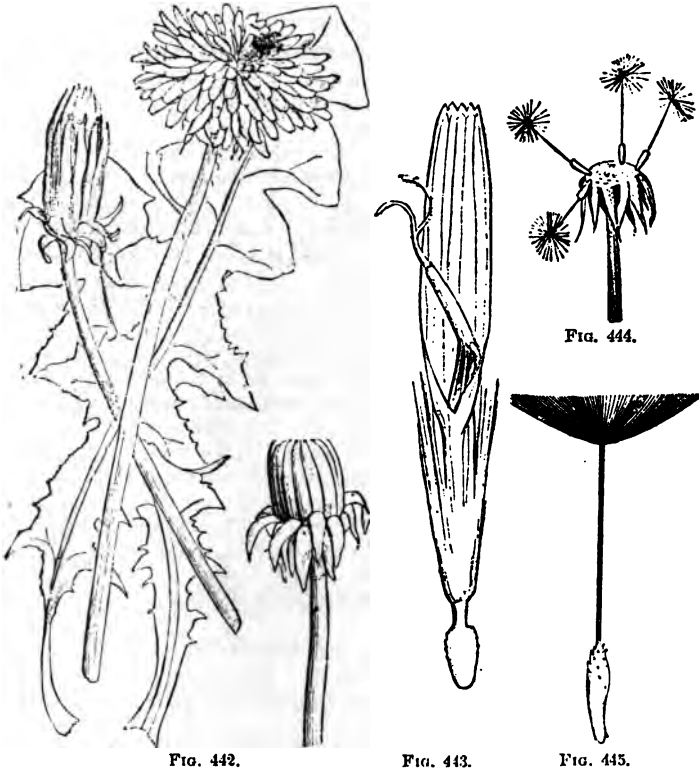


Fig. 442.—Head of flowers, with a bud on the right, a closed fruiting head on the left, and two leaves.

Fig. 443.—Flower. Magnified.

Fig. 445.—Fruit. Magnified.

Fig. 444.—Receptacle and fruits.

*C. arvensis*, the so-called Canada Thistle, is in reality an Old World species. It is one of the most difficult of all our weeds to eradicate on account of its underground stems, which are tenacious of life. *C. lanceolatus*, the Common Thistle, is another introduced species.



*C. pumilus*, the Pasture Thistle, and *C. horridulus*, the Yellow Thistle, are indigenous.

**Tribe 4. *Arctotideæ*.**—Flowers partly tubular (forming a central disk), and partly ligulate (forming rays to the head). Natives of Africa and Australia.

**Tribe 5. *Calendulaceæ*.**—Similar to the preceding. Natives mostly of Africa and Asia.

**Tribe 6. *Senecionideæ*.**—Heads mostly with disk and ray flowers.

*Arnica montana*, a perennial of Europe and Siberia, from which the official Arnica flowers and roots are derived.

*Senecio scandens*, of the Cape of Good Hope, is cultivated as a house plant under the name of German Ivy.

Many other species of this genus are cultivated—*e.g.*, the so-called Cinerarias, *Cacalia*, *Farfugium*, etc. Some of the species are common weeds.

*Bedfordia salicina*, a native of Tasmania, attains a height of four to five metres (15 ft.). Its wood is hard, and is much prized for cabinet work on account of its beautiful grain.

**Tribe 7. *Anthemideæ*.**—Heads mostly with disk and ray flowers.

*Artemisia Absinthium*, the Common Wormwood of Europe, is cultivated in old gardens as a domestic remedy. In Europe an alcoholic extract called Absinthe is used as an intoxicating beverage. Some species in the Rocky Mountain region are tall shrubs, and are called Sage Brush. They furnish a valuable fuel.

*Anthemis nobilis*, Chamomile, and *Tanacetum vulgare*, Tansy, of Europe, are well known domestic herbs.

*Chrysanthemum roseum*, from Persia, *C. Indicum*, from China, and *C. coronarium*, from North Africa, are the originals of the Chrysanthemums so common in flower-gardens.

*C. Leucanthemum*, the Ox Eye Daisy, is a most difficult weed to eradicate.

**Tribe 8. *Helenioideæ*.**—Heads mostly with disk and ray flowers.

To this belong the so-called French or African Marigolds, *Tagetes*, of several species, cultivated in flower gardens. They are in reality natives of tropical America.

**Tribe 9. *Helianthoideæ*.**—Heads mostly with disk and ray flowers.

*Dahlia variabilis* and one or two other species from Mexico, are the original forms of the Dahlias of the flower-gardens.

*Zinnia elegans*, of Mexico, is the well-known Zinnia of the gardens. *Coreopsis*, of several Arkansas and Texas species, are grown under the name of Calliopsis.

*Helianthus annuus*, the Common Sunflower, is a native of the Texan and Mexican regions. Aside from its ornamental use, its oily seeds are

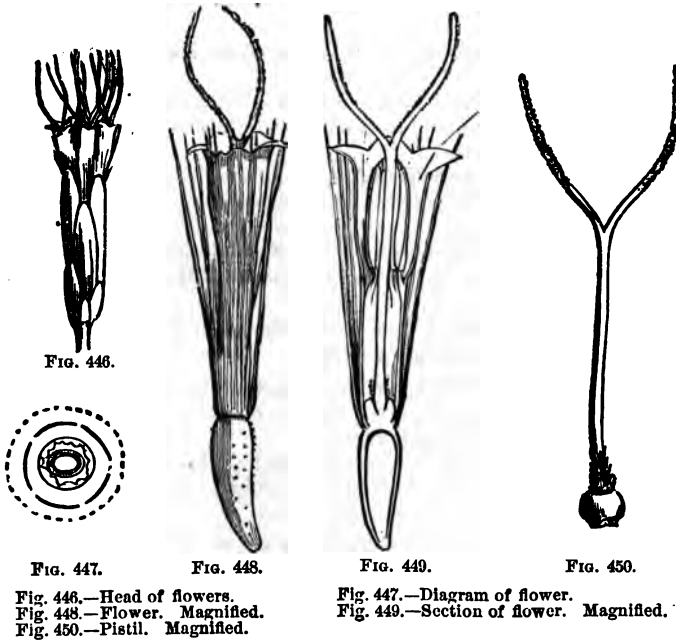
valuable for fattening poultry, and the dried stems are good for fuel. In Russia a valuable oil is obtained from the seeds.

*H. tuberosus*, the so-called Jerusalem or Brazilian Artichoke, is much grown for its potato-like tubers, which are fed to cattle and swine. It is probably derived from *H. doronicoides*, of the Mississippi Valley, by long cultivation. The name "Jerusalem" Artichoke is a corruption of the Italian *Girasola*—i.e., sunflower.

Among the weeds are the Ragweeds (*Ambrosia*), Cockleburrs (*Xanthium*), Spanish Needles (*Bidens*).

*Silphium laciniatum* is the Compass Plant of the Mississippi Valley.

FIGS. 446-50.—ILLUSTRATIONS OF EUPATORIUM.



Its large erect pinnately lobed leaves twist upon their petioles so as to present one surface of the blade to the east and the other to the west, the two edges being upon the meridian. (Fig. 134, p. 157.)

**Tribe 10. Inuloidæ.**—Heads mostly with disk and ray flowers.

*Helipterum Manglesi*, of Australia, is one of the "Everlasting flowers," cultivated under the name of Rhodanthe, and used for winter bouquets.

*Helichrysus*, sp., is also cultivated for the same purpose.

*Inula Helenium*, Elecampane, of Europe, is cultivated in gardens for its medicinal root.

**Tribe 11. *Asteroidæ*.**—Heads mostly with disk and ray flowers. Aside from our native species of *Aster* and *Solidago* (Golden Rods), which are ornamental, *Bellis perennis*, the English Daisy, and *Callistephus Chinensis*, the China Aster, are common in flower-gardens.

*Grindelia robusta* and other species are important as furnishing in the alcoholic infusion of their leaves a cure for the poisoning by Poison Ivy.

*Olearia argophylla*, the Musk Tree of Tasmania, attains a height of six metres (20 ft.) and a diameter of thirty cm. (1 ft.). Its wood is hard, and is used in turnery and in the manufacture of agricultural implements.

*O. furfuracea* and several other New Zealand species are equally valuable.

**Tribe 12. *Eupatoriaceæ*.**—Flowers all tubular. (Figs. 446-50) Species of *Eupatorium* are used as domestic medicines. Several of the species are ornamental.

*Mikania scandens*, a native climber, is cultivated for ornament.

The native species of *Liatris*, Blazing Star, are also quite ornamental.

**Tribe 13. *Vernoniaceæ*.**—Flowers all tubular.

The species of *Vernonia*, known by the name of Iron-weed, are common weeds on low grounds.

**Order *Calyceraceæ*.**—A few South American herbs resembling *Compositæ*, but with the ovule pendulous.

**Order *Dipsacæ*.**—Herbs, with distinct anthers and pendulous seeds, which contain endosperm. Species one hundred and twenty, mostly of the North Temperate Zone.

*Dipsacus Fullonum*, Fuller's Teasel, of Europe, is grown for its hard-bracted ripe heads, which are used by fullers in dressing woolen cloth.

*Scabiosa* contains many ornamental species.

**Order *Valerianaceæ*.**—Herbs, with distinct anthers, and three-celled, but (by absorption) one-seeded ovary; seed without endosperm. Species about three hundred, mostly of the North Temperate Zone.

*Valeriana officinalis*, of Europe, has a thickish root, which, in the dried state, is the officinal Valerian.

**589.—Cohort XXI. Rubiales.** Plants with actinomorphic or zygomorphic flowers; stamens inserted on the corolla and isomerous with its lobes; ovary inferior, two- to many-celled, each cell with one to many ovules. Calyx never pappose.

**Order *Rubiaceæ*.**—Herbs, shrubs, and trees; flowers generally reg-

ular (actinomorphic); leaves with stipules. A large order of over 4000 species, the greater part of which inhabit tropical countries. It is divided into twenty-five tribes, many of which differ so greatly from each other that they have been regarded as orders by some botanists.

The most common representatives of this order in the United States are the species of *Galium* (Bedstraw or Cleavers), *Mitchella* (Partridge Berry), and *Houstonia* (Bluets).

*Cephalanthus occidentalis*, the Button Bush of the Eastern United States, is a tall shrub bearing glossy green leaves and spherical heads of white, sweet-scented flowers. It deserves to be ranked among our ornamental shrubs.

*Pinckneya pubens*, a small tree of the Southeastern United States, is known as Georgia Bark, or Fever Tree, on account of the medicinal qualities of its bark.

*Cinchona*, of several species. This South American genus contains thirty or more species of trees; several of these, as *C. officinalis*, *C. cali-*

FIGS. 451-5.—ILLUSTRATIONS OF *COFFEA ARABICA*. ALL MAGNIFIED.

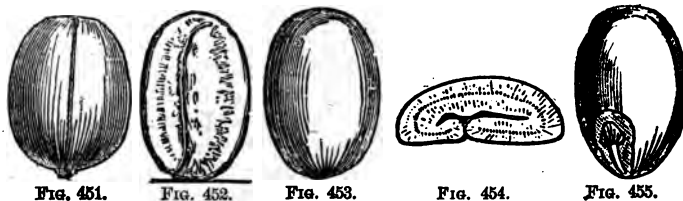


Fig. 451.—Berry.

Fig. 452.—Seed; ventral face.

Fig. 453.—Seed; dorsal face.

Fig. 454.—Transverse section of seed.

Fig. 455.—Dorsal face of seed, cut away to show embryo.

*saya*, *C. succirubra*, etc., all natives of the Andean regions of Peru, Bolivia, and New Granada, furnish the drug known as Peruvian Bark. This bark contains two important alkaloids, viz.: Cinchonina ( $C_{20}H_{24}N_2O$ ), and Quinia ( $C_{20}H_{24}N_2O_2 + 3H_2O$ ); the latter as a sulphate is the exceedingly valuable medicine, Quinia Sulphate, or Quinine. Cinchona trees are now cultivated in India, Java, Mauritius, and Jamaica.

*Cephaelis Ipecacuanha*, a semi-shrubby plant of Brazil, supplies from its roots the well-known emetic Ipecacuanha.

*Coffea Arabica*, the Coffee Tree, a native of Abyssinia, is a small-sized evergreen tree, bearing clusters of white flowers in the axils of the opposite glossy leaves. The red berries are about as large as cherries, and each contains two plano-convex seeds, the coffee seeds of commerce (Figs. 451-5). The Coffee tree was introduced into Arabia from four to five centuries ago, and into Java, by the Dutch, about two centuries ago. It has since been taken to Brazil and other parts

of South America, the West Indies, Ceylon, India, and many of the Pacific islands. Although originally from the same species, the Coffee trees now grown in different parts of the world produce seeds varying much in size, color, and quality; thus in "Mocha," from Arabia and Abyssinia, the seeds are small, of a dark yellow color, and when roasted produce an infusion of a most delicious quality; in "Java coffees" the seeds are larger, of a paler yellow color, and of scarcely inferior quality to the preceding; the coffees of Ceylon, West Indies, and Brazil (the latter particularly known as "Rio") have seeds of varying sizes, and of a bluish or greenish-gray color, and their infusions are generally inferior to those of the other varieties.

*Rubia tinctoria*, a perennial herb, native of the South of Europe and Western Asia, is the Madder Plant, now grown in many parts of the world for its roots, which yield the red dye known as Madder. The plant has whorled leaves and bears some resemblance to some species of *Galium*.

Among the ornamental plants of the order are many species of *Gardenia* from China and Africa, *Ixora*, *Portlandia*, *Boutardia*, etc.

**Order Caprifoliaceæ.**—Mostly woody plants, with generally zygomorphic flowers and stipulate leaves. This small family of two hundred species is mostly confined to the Northern Hemisphere. A drastic and purgative principle is common in the plants of the order, but none of the species are of much importance in medicine. Many species are ornamental—e.g., those of *Lonicera*, the Honeysuckles; *Symphoricarpos*, the Snowberries; *Diervilla*, the Bush-Honeysuckles, one species from Japan called Weigelia; *Viburnum*, the Snowball, etc., etc.

*Sambucus*, the Elder, has edible berries, which are much used for making into pies, preserves, jellies, wine, etc., in many parts of the United States.

III. CHORIPETALÆ (POLYPETALÆ of authors). Plants whose flowers generally have both calyx and corolla, the latter of separate petals.

**590.—Cohort XXII. Umbellales.**—Flowers usually actinomorphic; ovary inferior, one- to many-celled; ovules solitary, pendulous; seeds with endosperm.

**Order Cornaceæ.**—The Dogwood Family. Shrubs or trees, rarely herbs, with mostly opposite simple leaves; fruit a berry or drupe. A small order of about seventy-five species, mostly of the north temperate zone.

Several native and European species of *Cornus* are cultivated as ornamental shrubs.

*Aucuba Japonica*, from Japan, is a fine shrub of the flower-gardens. The wood of *Cornus florida*, the Flowering Dogwood of the Eastern

United States, is hard and fine-grained, and is sometimes used as a substitute for Boxwood.

The wood of *Nyssa multiflora*, the Sour Gum, Tupelo, or Pepperidge tree of the Eastern United States, is exceedingly difficult to split, and is much used for making hubs for wagon wheels.

**Order Araliaceæ.**—Shrubs or trees, rarely herbs, with mostly alternate compound leaves; fruit usually a berry or drupe. Species 340, mostly tropical.

Some of the species of *Aralia* are ornamental—e.g., *A. spinosa* and *A. racemosa*, of the Eastern and Southern United States.

*Hedera Helix*, the English Ivy of Europe and Western Asia, is a well-known ornamental climber.

*Aralia quinquefolia*, Ginseng, is common in many parts of the Eastern United States. Its root is officinal.

*Aralia papyrifera*, a small tree of China, is the source of the Chinese Rice paper; for this purpose the pith is cut into thin sheets and then pressed flat.

**Order Umbelliferae.**—Herbs, rarely shrubs or trees, with alternate and usually much dissected leaves; fruit dry and indehiscent. Species 1300,

found most abundantly in Northern Europe and Asia, although occurring in nearly all countries. Many contain an acrid poisonous principle, and the plants of the order may usually be regarded with suspicion. In a general way it may be said that the fruits are aromatic and innoxious, and the green parts acrid and poisonous. (Figs. 456–60.)

The Parsnip (*Pastinaca sativa*) and the Carrot (*Daucus Carota*), both natives of Europe, are valuable and well-known food plants. In their wild state they are poisonous.

*Apium graveolens*, Celery, a native of Europe, is deservedly popular

FIGS. 456-60.—ILLUSTRATIONS OF *FOENICULUM VULGARE*. ALL MAGNIFIED.

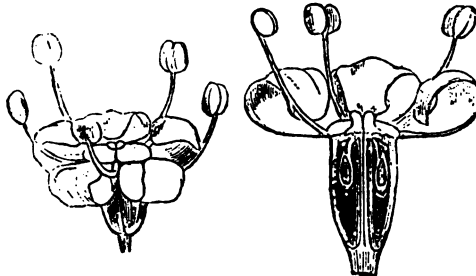


FIG. 456.

FIG. 457.

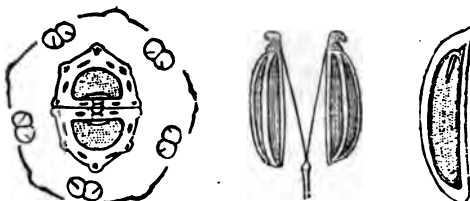


FIG. 458.

FIG. 459.

FIG. 460.

FIG. 456.—Flower.

FIG. 458.—Flower diagram.

FIG. 460.—Section of seed.

FIG. 457.—Section of flower.

FIG. 459.—Ripe fruit.

as a salad. The poisonous herbage, when deprived of its green color by covering with earth, is rendered wholesome.

Among the aromatic and medicinal products may be mentioned Caraway, Coriander, Cummin, Fennel (*Feniculum vulgare*), Dill, Aniseed, etc.

*Ferula Asafoetida* is a tall growing plant of Thibet and the western parts of Asia. The dried and hardened milky juice of the root is the nauseous smelling Gum Asafoetida. It is said that the Persians hold it in high esteem as a condiment. Gum Ammoniacum, Gum Galbanum, Gum Opopanax, and some other gum resins are similar strong smelling products of other plants of the same region.

*Conium maculatum*, Poison Hemlock, a native of Europe, but naturalized in the United States, is virulently poisonous. It is supposed to be the Hemlock used by the Greeks to poison their criminals and other offenders.

*Cicuta maculata*, Water Hemlock, and *Aethusa Cynapium*, Fool's Parsley, are two common poisonous plants, the first a native of the Eastern United States, the second introduced from Europe.

*Monizia edulis*, of the Madeiras, is a low tree, and in Australia species of *Xanthosia*, *Trachymene*, *Astrotrichia*, etc., are shrubs or small trees.

**591.—Cohort XXIII. Ficoidales.** Flowers usually actinomorphic; ovary mostly inferior, one- to many-celled; placenta parietal, basilar or axile; seeds with or without endosperm.

**Order Ficoidesæ.**—Mostly herbs, often with fleshy leaves. Species 450, mostly tropical, represented in the United States by the Carpet-weed (*Mollugo verticillata*).

*Mesembryanthemum crystallinum*, the Ice Plant, is commonly cultivated as a curiosity.

**Order Cactaceæ.**—The Cactus Family. Succulent herbs, shrubs, or trees, often spiny, and generally leafless. About 1000 species are enumerated, all American (with one or two exceptions), and mostly tropical. Several of the species are common in many parts of the Old World, having long since escaped from cultivation.

Many of the species are grown in conservatories for their fine flowers, as well as on account of their curious shapes. *Cereus grandiflorus*, the Night Blooming Cereus; *Opuntia vulgaris*, the common Prickly Pear; *O. coccinellifera*, and others, are common. The last-named is fed upon by the Cochineal Insect, from which the dye Carmine is derived.

The fleshy fruits of some species are edible.

**592.—Cohort XXIV. Passiflorales.**—Flowers usually actinomorphic; ovary usually inferior, syncarpous, one-celled,

with parietal placentæ (sometimes three or more celled by the produced placentæ).

**Order Datisacaceæ.**—A curious order of four species, one of which, *Datisca glomerata*, occurs in California.

**Order Begoniaceæ.**—A tropical order of 350 species of herbs, mostly

FIGS. 461-5.—ILLUSTRATIONS OF CUCUMIS MELO.



FIG. 461.

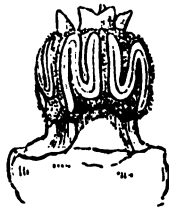


FIG. 463.

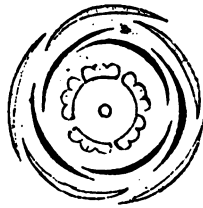


FIG. 464.

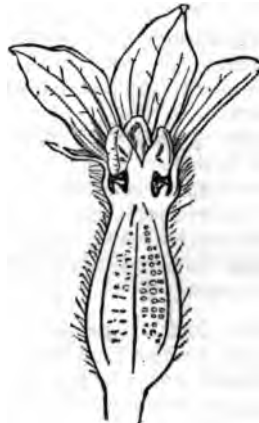


FIG. 462.



FIG. 465.

Fig. 461.—Male flower, vertical section.

Fig. 462.—Female flower, vertical section.

Fig. 464.—Diagram of male flower.

Fig. 463.—Androeclium. Magnified.

Fig. 465.—Diagram of female flower.

American, represented in green-houses and conservatories by many species of the principal genus *Begonia*—*e.g.*, *B. Rex*, *B. Evansiana*, *B. fuchsioides*, etc.

**Order Cucurbitaceæ.**—The Gourd Family. Herbs or undershrubs with climbing or trailing stems and diclinous flowers; placentæ produced to the axis of the ovary and revolute. Species 470, mostly tropical. (Figs. 461-5.)



*Cucurbita maxima*, the large Winter Squash; *C. verrucosa*, the Crook-necked Squash; and *C. Pepo*, the Pumpkin, are well known in cultivation. Their nativity is unknown. According to Dr. Gray, the Pumpkin was "cultivated as now along with Indian Corn by the North American Indians before the coming of the whites."

*Cucumis Melo*, the Musk-Melon, and *C. sativus*, the Cucumber, are doubtless natives of India.

*Citrullus vulgaris*, the Watermelon, is a native of India.

The dried flesh and seeds of *Citrullus Colocynthis*, of the Eastern Mediterranean region, constitutes the poisonous drug Colocynth.

*Lagenaria vulgaris*, the common Gourd, a native of Asia and Africa, is cultivated for its fruits, which are made into bottles, drinking vessels, etc.

*Luffa Egyptica*, the Towel Gourd of Egypt, is now grown in the West Indies and the Southern United States. Its fruit is somewhat larger than a Cucumber, and is very fibrous internally; its rind and seeds are removed, and the fibrous portion used as a bath sponge.

*Echinocystis lobata*, the Wild Cucumber or Balsam Apple of the Eastern United States, is a rapidly growing climber, valuable for arbors, screens, etc.

**Order Passifloraceæ.**—The Passion-Flower Family. Trees, shrubs, or herbs, mostly of the tropics. Species 250, represented in the Southern United States by four or five species of *Passiflora*, and in conservatories by magnificent climbers of the same genus from South America.

*Carica papaya*, the Papaw of tropical America, is a small tree, bearing large edible fruits.

**Order Turneraceæ.**—Tropical herbs and shrubs.

**Order Loasaceæ.**—Herbs of warm climates, mostly American.

**Order Samydaceæ.**—Trees and shrubs of the tropics.

**593. Cohort XXV.—Myrtales.** Flowers mostly actinomorphic; ovary usually inferior, syncarpous; placentæ in the axis (or apical, rarely basal); leaves simple, and usually entire.

**Order Onagraceæ.**—Herbs, shrubs, and trees, about 300 species, of temperate climates, represented in the United States by species of *Epilobium*, *Oenothera*, and other genera. In conservatories, many species of *Fuchsia* are cultivated for their beautiful flowers. They are natives of Mexico and South America.

*Trapa natans*, a curious aquatic plant of Central and Southern Europe, is called Water Chestnut, and its large nut-like horned fruits are nutritious. *T. dispinosa*, of Northern India, and *T. bicornis*, of China, are extensively used for food in their native countries.

**Order Lythraceæ.**—Herbs, shrubs, and trees, mostly of the tropics.

Species, 250, represented in the United States by a few small herbs of the genera *Lythrum*, *Cuphea*, etc.

*Lausonia inermis*, a shrub of Western Asia, has long been in cultivation in Egypt and the adjacent countries. From its leaves the cosmetic Henna or Khenna, so much used for coloring the hair and nails, is made.

*Punica granatum*, the Pomegranate of India, is a bushy tree, six to nine metres high (20–30 feet), bearing deciduous leaves, and yellowish fruits about the size of an apple. The pulpy interior of the latter is prized for making cooling drinks; from it a wine is also made. Pomegranates have long been grown in the countries about the Mediterranean Sea, and are now cultivated in the warmer parts of America.

*Lagerstræmia reginae*, the Jarool or Bloodwood tree of India, is highly valued for its blood-red wood, which, being exceedingly durable in water, is much used in shipbuilding.

*L. Indica*, a common green-house shrub from India, is cultivated under the name of Crape Myrtle.

*Sonneratia acida*, an Indian tree, yields a most valuable fuel.

*Physocalymma floribunda*, the Tulip tree of Brazil, yields a fine wood much used for inlaying.

**Order Melastomaceæ.**—Trees, shrubs, and a few herbs, of the tropics. Species, 1800. We have in the United States but one genus, *Rhexia*, represented by half a dozen species. A few are cultivated in green-houses.

**Order Myrtaceæ.**—The Myrtle Family. Trees and shrubs (rarely herbs), with mostly opposite glandular-dotted leaves; stamens, many. A large and very difficult order of 1800 or more species, which are distributed throughout the tropics and the Southern Hemisphere.

Many of the species yield excellent fruits.

*Psidium pomiferum* and *P. pyrifera*, of the West Indies, and *P. Catleianum*, of Brazil, bear apple- or pear-shaped fruits called Guavas, highly esteemed for dessert, and for preserving. All are now extensively grown in tropical climates.

*Eugenia malaccensis*, the Malay Apple, and *E. Jambos*, the Rose Apple, both of the East Indies, furnish important fruits to the people of the far East.

*E. pimenta*, a West Indian tree, is there cultivated for its berries, which are gathered and dried before ripening, constituting the Pimento or Allspice of commerce.

*E. aromatica*, the Clove Tree of the Moluccas, now extensively cultivated in the East and West Indies, is prized for its spicy flower-buds, which are gathered before opening and then dried, in which state they are known as Cloves.

*Bertholletia excelsa*, of tropical America, is a tree thirty to forty-five metres high (100–150 feet), bearing woody-shelled fruits, ten to fifteen

cm. (4-6 inches) in diameter, inside of which are a number of rough oily seeds, the Brazil Nuts of commerce. Closely related to this is the Monkey Pot, whose woody-shelled fruit is deliscent by a circular lid.

Many of the trees of this order furnish valuable timber.

*Myrtus communis*, the Myrtle Tree of Western Asia, yields a hard mottled wood much esteemed in turnery. (Fig. 466.)

*Eucalyptus*, sp., the Gum Trees of Australia and Tasmania. These are large stately trees, often rising to the height of fifty to one hundred metres (150-300 feet), and occasionally even exceeding this. The timber furnished by them is in some cases of great value, being tough and durable. (Figs. 467-8.)

*E. globulus*, the Blue Gum, is now much planted in California. Its timber is valuable, but shrinks greatly in drying. *E. marginata*, "the Jarrah or Mahogany tree of Southwestern Australia is famed for its indestructible wood, which is attacked neither by *Chelura*, *Teredo*, nor

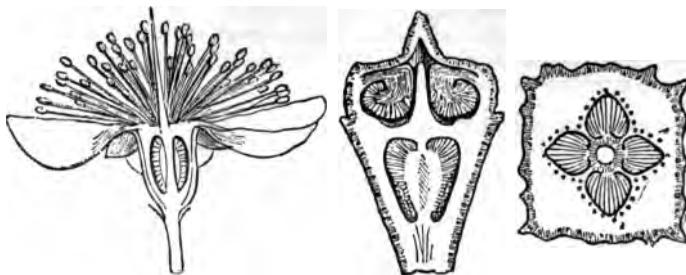


FIG. 466.

FIG. 467.

FIG. 468.

Fig. 466.—Vertical section of the flower of *Myrtus communis*. Magnified.

Fig. 467.—Vertical section of the flower bud of *Eucalyptus globulus*. Nat. size.

Fig. 468.—Transverse section of the ovary of *Eucalyptus globulus*. Magnified.

*Termes*, and therefore much sought for jetties and other structures exposed to sea water, also for underground work, and largely exported for railway sleepers. Vessels built of this timber have been enabled to do away with copper-plating." (Mueller). *E. resinifera*, the Iron Bark tree supplies a very heavy and exceedingly strong timber.

Species of *Eugenia*, *Myrtus*, etc., are grown in conservatories.

**Order Combretaceæ.**—Tropical trees and shrubs, about 240 species. A few species occur in South Florida.

**Order Rhizophoraceæ.**—Tropical trees and shrubs, about 50 species, the most important of which is the Mangrove Tree of tropical America (*Rhizophora Mangle*); it also occurs from Florida to Texas.

**594. Cohort XXVI.—Rosales.** Flowers mostly actinomorphic; carpels one or more, usually quite free in bud,

sometimes variously united afterwards with the calyx-tube,

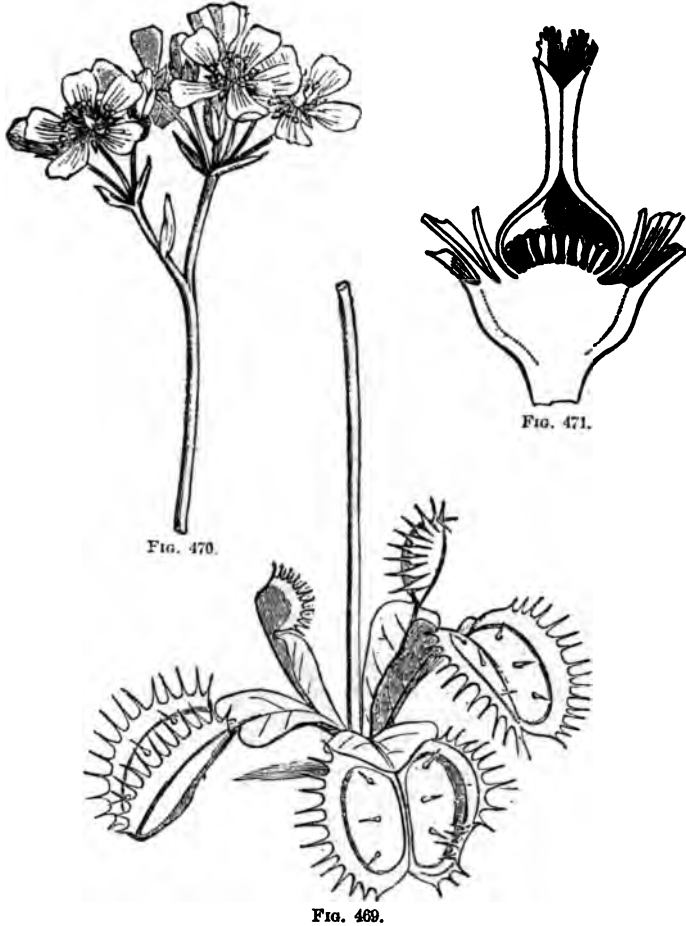


FIG. 469.  
 FIG. 470.—*Dionæa muscipula*. Plant with flower-stalk. Natural size.  
 FIG. 471.—Pistil cut vertically. Magnified.

or enclosed in the swollen top of the peduncle; styles usually distinct.

**Order Haloragææ.**—Mostly aquatic herbs, about eighty species.

**Order Bruniaceæ.**—A few heath-like woody plants of South Africa.

**Order Hamamelaceæ.**—A small order of trees and shrubs, represented in the United States principally by the Witch Hazel (*Hamamelis Virginica*), and the Sweet Gum Tree (*Liquidamber Styraciflua*).

**Order Droseraceæ.**—The Sundew Family. Mostly bog-herbs with radical gland-bearing leaves. About 110 species are known, distributed throughout the world. This interesting little family has attracted great attention on account of the insect-catching habits of its species.

The most remarkable plant of the order is the Venus' Fly-Trap (*Dionaea muscipula*) of North Carolina. Each leaf has a rounded blade which is fringed with stiff bristles (Fig. 469), and upon the surface of each half are three sensitive hairs which, when touched, cause the tissues of the upper surface of the midrib to contract suddenly, and thus to quickly close the leaf as a book or rat-trap is closed. An insect alighting upon one of these leaves is caught by the quickly-closing sides, and is within a few days dissolved (digested) by an acidulous fluid exuded by the glands of the leaf; it is then absorbed by the leaf, and when this is accomplished the latter again opens. This plant is thus a partial saprophyte!

In the Sundews (species of *Drosera*), the leaves have stalked glands which are sensitive, and when these come in contact with an insect they cause the blade to slowly bend around it, finally enclosing it. Digestion and absorption then take place as in the previous case.

Mr. Darwin has shown that the other genera of the order are also insectivorous. (See his book, "Insectivorous Plants," London and New York, 1875, in which 367 pages are devoted to the plants of this order).

**Order Crassulaceæ.**—Herbs or undershrubs, usually with thick fleshy leaves. Species 400, found mostly in temperate climates. Many are in common cultivation—e.g., *Bryophyllum*, the Live-leaf from tropical Africa; *Crassula*, of many species, from the Cape of Good Hope; *Cotyledon*, of many species, from Mexico and Africa; *Sedum*, Live-forever; *Sempervivum*, the Houseleek, etc.

**Order Saxifragaceæ.**—The Saxifrage Family. Trees, shrubs, and herbs with actinomorphic flowers, generally definite stamens, and seeds rich in endosperm. Species 540, mostly natives of temperate and cold climates.

*Ribes grossularia*, the Gooseberry, and *R. rubrum*, the Red Currant, both of Europe, are in common cultivation for their edible berries. The last named is also indigenous northward in this country.

Among ornamental plants are *Philadelphus*, the Mock Orange, from the Old World; *Ribes*, Flowering Currants, of the Western United States; *Deutzia*, from China and Japan; *Hydrangea*, Japanese and native; *Astilbe*, from Japan; *Saxifraga sarmentosa*, the so-called Strawberry Geranium, a fine basket plant from China.

*Cephalotus follicularis*, the Australian Pitcher Plant, is now regarded

as a member of this order. It is a low plant with a rosette of radical leaves, some of which resemble the covered pipes used by many Frenchmen (Fig. 472). The border of the ascidium (pitcher) in the latter is incurved and presents an obstacle to the egress of insects, which are no doubt thus captured.

**Order Rosaceæ.**—The Rose family. Herbs, shrubs, and trees, usually with actinomorphic flowers, generally indefinite (many) stamens, and seeds destitute of endosperm. Species, 1000, distributed throughout the world. The plants here under consideration have been arranged under several orders by some authors, on account of a part having an apparently inferior 5-celled ovary, others many superior ovaries, and still others but one superior ovary. Bentham and Hooker have arranged the seventy-one genera under ten tribes, eight of which only will be noticed here.

**Tribe Pomeæ.**—Shrubs and trees with simple leaves, ovaries 5 (rarely less), adnate to and frequently covered by the fleshy receptacle (and calyx?).

*Pirus Malus*, the Apple, and *P. communis*, the Pear, grow

wild in many parts of Europe. They have been cultivated for ages in other portions of the world. (Fig. 473.)

*P. prunifolia* and *P. baccata*, Siberian Crab-Apples, of the North of Asia, are in common cultivation.

*P. coronaria*, the American Crab-Apple, of the Eastern United States, might be made a valuable apple by cultivation.

*P. Cydonia* (or *Cydonia vulgaris*), the Quince, is a native of the Levant. (Figs. 474-5.)

The Hawthorns (*Crataegus*, sp.) are of some value for their fruits, and have long been favorites for hedges and ornamental purposes, Service-berries (*Amelanchier*, sp.) furnish valuable fruits, and are ornamental.

**Tribe Roseæ.**—Shrubs, with pinnately compound leaves; ovaries many, free, but surrounded by the fleshy receptacle (and calyx?).

*Rosa*—of many species—the Roses. Not only are our native species (of which we have about a dozen) more or less cultivated for their beau-

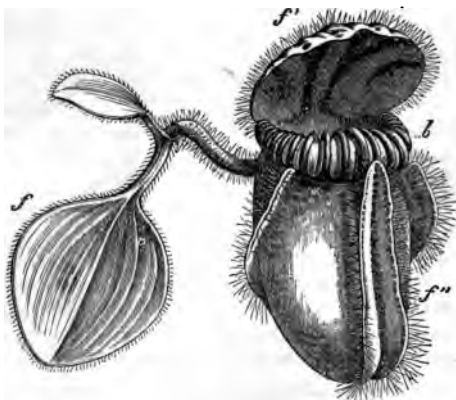


Fig. 472.—Leaves of *Cephalotus follicularis*. *f*, normal foliage leaf; *f''*, ascidium; *d*, its incurved border; *f'''*, its lid. Natural size.

tiful flowers, but from eighteen to twenty or more species from Europe and Asia are commonly to be found in gardens and conservatories. (Fig. 476.)

**Tribe *Potentilleæ*.**—Mostly herbs, with usually compound

FIGS. 473-5.—ILLUSTRATIONS OF TRIBE *POMEÆ*.



FIG. 473.

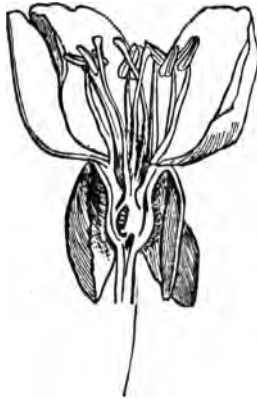


FIG. 474.

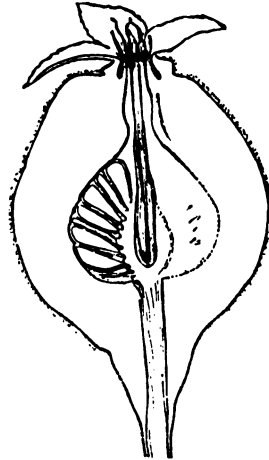


FIG. 475.

Fig. 473.—Flower cluster of *Pirus communis*.

Fig. 474.—Section of Quince flower (*Pirus Cydonia*).

Fig. 475.—Section of Quince fruit.

leaves ; carpels free, one to many, mostly on a convex fleshy receptacle ; fruits dry (achenia).

*Fragaria clatior*, of Europe, *F. vesca*, of Europe and Eastern United

States, and *F. Virginiana* of the Eastern United States, are the species from which the cultivated Strawberries have been derived, by high culture and crossing. (Fig. 477.)

*Chamaebatia foliosa* of the western slope of the Sierra Nevada Mountains in California, is a small fragrant shrub with thrice pinnate leaves, much gathered by tourists, and deserving a place in gardens.

*Cercocarpus ledifolius*, the Mountain Mahogany, of California, is a shrub or tree, ranging from two to fifteen metres in height (6 to 50 feet). Its heavy dark colored wood is valuable.

**Tribe Rubeæ.**—Mostly shrubs, differing from the preceding in having fleshy fruits (drupes).

*Rubus Idæus*, the Garden Raspberry, of Europe, is also cultivated to some extent in this country.

*R. occidentalis*, the Black Raspberry, and *R. strigosus*, the Red Raspberry, both natives of the Eastern United States, have given rise to the Common Raspberries of our gardens.

*R. fruticosus*, the Blackberry, of Europe, is scarcely, if at all cultivated in this country. *R. villosus*, the Wild Blackberry, of the Eastern

United States, is extensively cultivated.

**Tribe Quillajææ.**

—Trees and shrubs, with mostly simple leaves, dry fruits and winged seeds. Nearly all are natives of Mexico or South America.

*Quillaja saponaria*, of Chili, is an evergreen tree, fifteen to eighteen metres (50 to 60 feet)

high, whose bark contains Saponin ( $C_{42}H_{84}O_{16}$ ), and is used instead of soap for washing. Under the name of Soap-bark or Quillaja-bark it is imported into this country.

**Tribe Spiræææ.**—Mostly woody plants, of the Northern Hemisphere, with dry fruits. The principal genus *Spiræa*, contains many species, which, being highly ornamental, are commonly planted in flower-gardens.

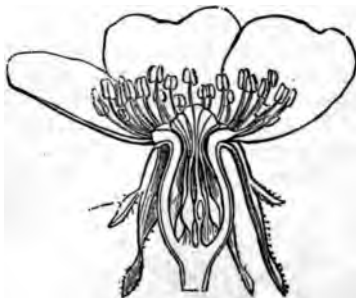


Fig. 476.—Section of the flower of *Rosa rubiginosa*. Natural size.



Fig. 477.—Section of the flower of *Fragaria vesca*. Magnified.



(*P. nana*), the Lima Bean (*P. lunatus*), probably all from India and Western Asia.

Many more species are now cultivated in India, such as Chowlee, Black Grain, Soy, Pigeon Pea, Lentils, etc.

The Peanut (*Arachis hypogæa*), a native of South America, is now an important food plant in the West Indies and Africa. After the fertilization of the erect yellow flowers, the peduncles bend down and the young pods are thrust into the ground, where they ripen. This curious habit, which must have been at first a protective one, is perpetuated in cultivation, although the need of it apparently no longer exists.

The forage plants include the Red Clover (*Trifolium pratense*), the White Clover (*T. repens*), Lupine (*Lupinus albus*), Lucerne (*Medicago sativa*), Sanfoin (*Onobrychus sativa*), Tares or Vetches (*Vicia sativa*), all from Europe and the countries adjacent to the Mediterranean Sea. Many others are grown less extensively.

Of the timber trees, the following are the most important :

*Robinia Pseud-Acacia*, the Locust Tree of the Eastern United States, yields a very strong and durable timber.

*Dalbergia nigra*, a large tree of Brazil, produces the finest Rosewood.

*D. latifolia*, of India, produces the Indian Rosewood.

The valuable dye Indigo is obtained from *Indigofera tinctoria*, a native of India. The flowering plants are cut and placed in vats of water ; after remaining for a time, the water, now colored, is drawn off, and after several intervening processes, the coloring matter is allowed to settle to the bottom ; this when dried is crude indigo.

The wood of *Pteropus santalinus*, a tree of India, when reduced to chips, is the red dye known as Red Sandal-wood, or Saunders.

Camwood, another red dye, is obtained in a similar manner from *Baphia nitida*, a West African tree.

Some species furnish gums and balsams, which are of use in the arts.

Gum Tragacanth is derived from a low shrubby plant, *Astragalus tragacantha*, growing in Western Asia.

Gum Kino is produced by large trees of India and Africa belonging to the genus *Pterocarpus*.

Balsam of Peru and Balsam of Tolu are the products of species of *Myrcylon*, in Central and South America.

But one important medicinal product is furnished by this sub-order, viz., Liquorice, the dried roots of *Glycyrrhiza glabra*, a native herb of the South of Europe.

In India species of *Crotalaria* and *Sesbania* are extensively cultivated for their strong and durable fibre, much used for making cordage and coarse cloth.

Of the many ornamental plants, the following only can be mentioned, viz., species of *Lupinus*, *Cytisus*, *Laburnum*, *Petalostemon*, *Caragana*, *Robinia*, *Wistaria*, *Phaseolus*, *Lathyrus*, *Sophora*, etc., etc.

*Desmodium gyrans*, an East Indian plant, is remarkable for the spontaneous movements of its leaves. The leaves are compound, the terminal leaflet being large, while the lateral ones are small; under proper conditions the lateral leaflets alternately rise and fall by quick jerks, continuing this for hours without any apparent external cause.

**Sub-Order II. *Cæsalpintææ***, with flowers zygomorphic or actinomorphic; stamens generally ten, usually distinct.

The Tamarind is the fruit of a North African and East Indian tree of this sub-order, *Tamarindus Indica*.

Senna, a medicinal drug, is the dried foliage of African and East Indian species of *Cassia*.

Gum Copal, much used in making varnishes, is derived, at least in part, from East Africa and Madagascar trees belonging to the genera *Trachylobium* and *Hymenæa*.

Copaiva Balsam is obtained from Brazilian trees (*Copaifera*, sp.) by making deep incisions into the trunks.

The pulverized wood of *Cæsaipina echinata*, a Brazilian tree, yields the red dye Brazil-wood; that from *Hæmatoxylon Campeachianum*, a small tree of Central America, is the well-known and valuable dark-red dye Logwood.

Many timber trees are of great value—*e.g.*, the Mora Tree of Guiana (*Dimorphandra Mora*), whose heavy durable timber is in great repute in the British navy yards; the West India Locust (*Hymenæa Courbaril*), used in ship-building; the Honey Locust of the Eastern United States (*Gleditschia triacanthos*), which furnishes a valuable timber used by wheelwrights for making hubs; the Kentucky Coffee Tree of the Eastern United States (*Gymnocladus Canadensis*), whose red wood somewhat resembles Mahogany; the Judas Trees (*Cercis*, sp.), whose wood is prized in Europe for cabinet-making.



Fig. 487. — Cross-section of the seed of *Cassia tora*, showing the abundant endosperm.—Magnified.

**Sub-Order III. *Mimoseæ***.—Flowers actinomorphic, small, and generally collected into close heads or spikes; stamens distinct, two to many times the number of petals.

One of the most important of the vegetable gums—Gum Arabic or Gum Acacia—is furnished by trees of this sub-order belonging to the genus *Acacia*. The greatest supply is obtained from *A. vera* and *A. Arabica*, natives of Northern Africa, Arabia, and the East Indies.

The genus *Acacia* is abundantly represented in Australia, where many of its species, called Wattles, yield most excellent timber. That of *A. melanoxylon* "is most valuable for furniture, railway carriages, boat-building, casks, billiard-tables, piano-fortes (for sounding-boards and actions), and numerous other purposes. The fine-grained wood is cut into veneers. It takes a fine polish, and is considered equal to the best walnut." (*Mueller*.)

*Lysiloma Sabicu*, a large Cuban tree, yields a hard and very durable timber, highly valued for ship-building and for other purposes.

Many species of *Acacia* and *Mimosa* are in cultivation in gardens and conservatories.

*Mimosa pudica*, from South America, is interesting on account of its extreme sensitiveness to a touch or jar. On this account it is commonly known as the Sensitive Plant. Its leaves expand in the light and contract in darkness, and in the proper temperature close at once upon

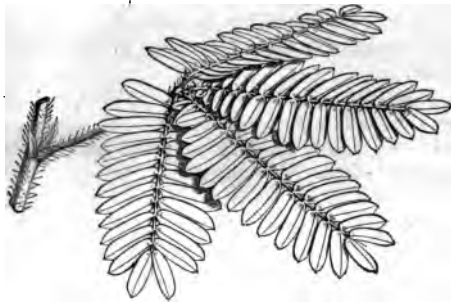


FIG. 488.

Fig. 488.—Expanded compound leaf of *Mimosa pudica*.



FIG. 489.

Fig. 489.—Closed leaf of the same.

being touched or jarred, opening again, however, in a few minutes (Figs. 488-9).

**Order Connaraceæ.**—Trees and shrubs of the tropics, one of which, *Connarus Lambertii* of Guiana, furnishes the beautiful Zebra-wood.

**595.—Cohort XXVII. Sapindales.** Shrubs and trees, with usually compound leaves. Flowers often zygomorphic and diclinous; ovary superior; seeds usually without endosperm.

**Order Moringeæ.**—Contains three Old World trees, of doubtful affinity.

**Order Coriariæ.**—Shrubs of one genus and three to five species, found in the Mediterranean region, the Himalayas, Japan, New Zealand, and South America. Their affinities are very obscure.

**Order Anacardiaceæ.**—The Cashew Family. Trees and shrubs, with gummy or milky-resinous juice, often poisonous; fruit usually a drupe. Species about 450, chiefly found in the tropics. The common

representatives of this order in this country are species of *Rhus*, of which *R. typhina* and *R. glabra*, Sumach, are highly ornamental, as well as useful, their young shoots and leaves containing much tannin and being much used in tanning.

*Rhus Toxicodendron*, the Poison Ivy, and *R. venenata*, the Poison Sumach, both of the Eastern United States, and *R. diversiloba*, the "Poison Oak" of California, are very poisonous, causing in many persons a severe cutaneous eruption.

*Mangifera Indica*, of India, but now grown in most warm climates, produces the excellent fruit known as the Mango.

The Cashew Nut is the product of a large West Indian tree, *Anacardium occidentale*, and the Pistachia Nut of a tree of Western Asia, *Pistacia vera*.

Mastic, a resinous material used in fine varnishes, is obtained by making incisions into the stem of *Pistacia Lentiscus*, a small tree of the Mediterranean region. Japan Lacquer, so much used by the Japanese in the manufacture of many wares, is obtained in a similar way, from *Rhus vernicifera*, and probably other species. Japanese Wax is derived from the waxy-coated seeds of *R. succedaneum*, a tree of China and Japan.

*Schinus molle*, a Peruvian shrub, is much grown for ornament in the gardens of California and Italy.

**Order Sabiaceæ.**—Trees and shrubs, mostly of the tropics.

**Order Sapindaceæ.**—Trees and shrubs (rarely herbs), mostly with compound or lobed leaves. Species from 600 to 700, widely distributed. This order includes five well-marked sub-orders, as follows:

**Sub-Order I. Staphyleæ**, with actinomorphic flowers, and seeds with endosperm. Represented in the Eastern United States by the native ornamental shrub, the Bladder Nut (*Staphylea trifolia*).

**Sub-Order II. Meliantheæ**, with zygomorphic flowers, and seeds with endosperm. Old World trees and shrubs.

**Sub-Order III. Dodonææ**, with actinomorphic flowers, and seeds without endosperm; leaves alternate.

*Pteroxylon utile*, the Sneezewood Tree of the Cape of Good Hope, furnishes a hard and durable timber, as also a New Zealand tree, *Alectryon excelsum*.

**Sub-Order IV. Acerineæ**, with actinomorphic flowers, and seeds without endosperm; leaves opposite. (Figs. 490-2.)

The genus *Acer*, the Maples, contains nearly all the species.

*A. campestre*, the Common Muple of Europe, *A. Pseudo-Platanus*, the Sycamore Maple of Europe and Western Asia, and *A. platanoides*, the Norway Maple of Europe, are valuable timber trees, occasionally planted here as ornaments.

*A. saccharinum*, the Sugar Maple, *A. rubrum*, the Red Maple, and

*A. dasycarpum*, the Silver Maple, all of the Eastern United States, furnish timber much used in the manufacture of furniture.

From the sweet sap of the first much sugar is made in the Northern United States. Its wood also is harder, and is known as Hard Maple, to distinguish it from Soft Maple, derived from the other species.

*A. macrophyllum*, the Large Leaved Maple, and *A. circinatum*, the

FIGS. 490-2.—ILLUSTRATIONS OF ACER PÆUDO-PLATANUS.



FIG. 490.



FIG. 491.

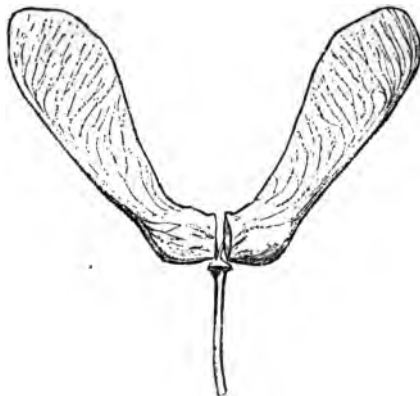


FIG. 492.

Fig. 490.—Section of flower. Magnified.  
Fig. 492.—Ripe fruit.

Fig. 491.—Flower diagram.

Vine Maple, both of California and Oregon, yield a hard and close-grained timber.

*Negundo aceroides*, the Box Elder of the Eastern United States, is a fine ornamental tree. *N. Californicum*, of the Pacific Coast, is much like the preceding.

**Sub-Order V. Sapindæ.**—Flowers actinomorphic or zygomorphic; seeds without endosperm; leaves mostly alternate. (Fig. 493.)

*Æsculus glabra*, the Ohio Buckeye, and several other species, are native ornamental trees of the sub-order.

*Æ. Hippocastanum*, the Horse-Chestnut of the Old World, is commonly planted.

*Kelreuteria paniculata*, a Chinese tree, and *Cardiospermum Halicababum*, the Balloon Vine of the Southern United States, are cultivated as ornaments.

*Nephelium Litchi*, a small Chinese tree, produces the pulpy edible fruits imported under the name of Litchi. *N. Longan* produces the similar fruit called Longan.

*Melicocca bijuga*, a tree of Guiana, yields a hard and heavy timber, and from *Cupania pendula*, of Australia, is obtained Tulip Wood, which, in some respects, resembles Mahogany.

The stem of the climbing plant, *Paullinia curassavica*, of Venezuela, is made into the walking-sticks called "Supple Jacks."

596. — Cohort XXVIII. Celastrales. Flowers actinomorphic and monoclinous; ovary superior entire; seeds usually with endosperm.

**Order Ampelidææ.** — Mostly climbing shrubs, with nodose stems, bearing petioled alternate leaves; tendrils and flower clusters opposite to the leaves. About 250 species are known; they abound in the tropics and are much rarer in temperate climates.

*Vitis* is the principal genus; it contains all the true Vines (grape producing), and many others whose fruits are inedible. (Figs. 494-501.)

*Vitis vinifera*, the Vine of the Old World, has been under cultivation from time immemorial. It is indigenous to Southern Asia, from whence it has been carried to nearly all parts of the world. Its varieties are almost innumerable. From those grown in Southern Europe wines and raisins are made, the latter being merely the sun-dried grapes.

In the United States the Old World Vine is grown in the Southern and Pacific Coast States, and in the latter region fine raisins are made. In other portions of this country only the native species are grown, viz.:

*V. Labrusca*, the Northern Fox Grape; from this have originated most of the common varieties, as Catawba, Concord, Isabella, etc.

*V. æstivalis*, the Summer Grape, from which we have obtained the Virginia Seedling, Herbemont, etc.

*V. riparia*, the River-bank Grape, which has produced the Taylor Bullit, Delaware, and Clinton.



Fig. 493.—Diagram of the flower of *Æsculus*; the normal circle of stamens shaded black; of the interposed ones but two are fully developed, shaded lighter, the abortive ones represented by dots.—After Sachs.

*V. vulpina*, the Southern Fox Grape, which has given rise to the Scuppernon and other varieties.\*

From these American grapes excellent wines are now made; but no raisins have yet been made from them.

The Virginia Creeper, *Ampelopsis quinquefolia* (or *Vitis quinquefolia*),

FIGS. 494-501.—ILLUSTRATIONS OF *VITIS VINIFERA*.

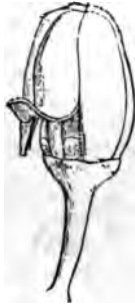


FIG. 494.

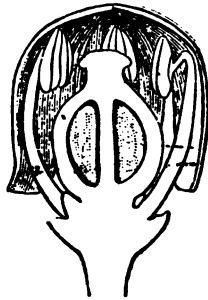


FIG. 495.

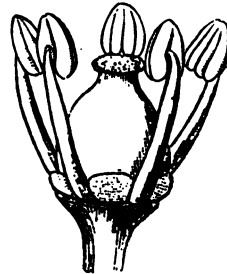


FIG. 496.



FIG. 497.



FIG. 498.



FIG. 499.



FIG. 500.



FIG. 501.

Fig. 494.—Flower bud. Magnified.

Fig. 495.—Section of flower-bud. Magnified.

Fig. 496.—Flower without corolla. Magnified.

Fig. 497.—Flower diagram.

Fig. 498.—Fruit.

Fig. 499.—Seed. Magnified.

Fig. 500.—Cross-section of seed. Magnified.

Fig. 501.—Vertical section of seed. Magnified.

is one of our finest native ornamental climbers.

Javan and Sumatran species of *Vitis*, formerly referred to *Cissus*, are common in conservatories.

**Order Rhamnaceæ.**—Trees and shrubs, often spinescent, bearing simple, usually alternate leaves; flowers with valvate calyx lobes. Species 430. Inhabitants for the most part of warm and temperate regions. Many possess a purgative principle.

\* This distribution of the cultivated varieties is that made by Dr. George Engelman. *American Naturalist*, 1872, p. 539.

The fruits of some species of *Rhamnus* yield yellow or green dyes, which are of considerable importance.

The wood of *R. frangula*, of Europe, is used for making the best charcoal for the finest gunpowder.

Species of *Zizyphus* in Africa and India produce edible fruits, one of which is the Jujube.

*Rhamnus catharticus*, the Buckthorn of Europe, is planted in this country for hedges.

**Order Stackhousiæ.**—Small herbs, mostly confined to Australia.

**Order Celastraceæ.**—Small trees and shrubs, often climbing, bearing simple, usually alternate leaves; flowers with imbricate calyx lobes. Species about 400, natives of temperate and tropical regions.

*Celastrus scandens*, the Climbing Bittersweet of the Eastern United States, is ornamental, and is planted in this country and Europe.

*Euonymus atropurpureus*, the Waahoo, or Burning Bush of the Eastern United States, is also found in gardens.

The wood of *E. Europæus* of Europe is compact and capable of being split into very fine pieces, and is used by watch-makers under the name of Dogwood. It is also used for skewers, shoe-pegs, etc.

From the leaves of *Catha edulis*, an East African shrub, a decoction is made which produces an agreeable excitement. The leaves themselves are sometimes chewed.

**597.—Cohort XXIX. Olacales.** Flowers actinomorphic; ovary superior, entire, one- to many-celled; seeds with copious endosperm.

**Order Cyrillaceæ.**—Trees and shrubs, numbering eight species, represented in the Southern United States by *Cyrilla racemiflora*, the Ironwood, and *Cliftonia ligustrina*, the Buckwheat Tree, the latter a handsome evergreen tree, three to six metres high (10 to 20 feet).

**Order Ilicinæ.**—The Holly Family. Trees and shrubs with mostly evergreen leaves, and three- to many-celled ovary. Species 150, of tropical and temperate climates.

*Ilex Aquifolium*, the Holly Tree of Europe, yields a white close-grained wood much esteemed by turners and cabinet-makers. It is sometimes blackened so as to resemble ebony. The tree, being ornamental, is extensively planted. The bright red berries remain during the winter, and with the evergreen foliage are used for Christmas decorations.

*I. opaca*, the American Holly, of the Southern States and the Atlantic coast from Massachusetts southward, resembles the preceding and is used for the same purposes. This and other native species are cultivated in gardens.

The leaves of *I. Paraguayensis*, a small South American tree, furnish



the Paraguay tea, sometimes called Maté. It contains Caffeine, the active principle in tea and coffee.

**Order Olacineæ.**—Trees and shrubs, about 170 species, almost entirely of the tropics.

**596.—Cohort XXX. Geraniales.** Flowers often zygomorphic; ovary superior, entire, lobed, or sub-apocarpous.

**Order Chailletiacæ.**—Tropical shrubs and trees.

**Order Meliaceæ.**—Trees (rarely undershrubs), with mostly pinnately compound leaves; stamens united into a tube; ovary entire. Species, 270, nearly confined to the tropics.

Several trees yield valuable timber.

*Melia Azedarach*, the Pride of India Tree, indigenous throughout Western Asia, now naturalized in all the Mediterranean region, and the Southern United States, is a fine tree, whose reddish wood is susceptible of a beautiful finish.

*Swietenia Mahagoni*, a native of tropical America (barely reaching South Florida), yields the well-known Mahogany wood. The trees are of great thickness, sometimes being as much as two metres in diameter.

*Cedrela odorata*, of Jamaica, yields Jamaica Cedar.

*C. Toona*, of India, produces Chittagong wood.

*C. australis*, an immense Australian species, resembles the Jamaica Cedar. The wood of the three foregoing species of *Cedrela* is fine grained, and well adapted to many uses.

*Chloroxylon Swietenia*, of Ceylon and Western India, is a large tree, whose fine-grained satin-like wood, called Satin Wood, is much prized in cabinet and furniture making and fine turnery.

**Order Burseracæ.**—Trees and shrubs, abounding in resinous or oily secretions; species, 145, nearly all tropical.

*Balsamodendron Myrrha* and *B. Kataf*, small Arabian trees, yield Myrrh.

*B. Africanum*, of Eastern Africa, produces African Bdellium.

Olibanum, an incense resin, is obtained from *Boswellia thurifera*, a lofty tree of Central India.

*Bursera gummifera*, West Indian Birch, of South Florida and the West Indies, yields a gum resin called Chibou or Cachibou.

**Order Ochnacæ.**—Tropical shrubs and trees with a watery juice.

**Order Simarubacæ.**—Shrubs and trees, with scentless foliage; leaves generally compound and alternate; stamens distinct. About 112 species, almost confined to the tropics, are known. The bitter bark and wood of many species are made use of in medicine. That from *Quassia amara*, a small tree of tropical America, is the Quassia of pharmacy. From a West Indian tree, *Simaruba amara*, the drug *Simaruba Bark* is obtained.

*Ailanthus glandulosus*, the Tree of Heaven, a native of China, is commonly planted in the United States as a shade tree. Its wood is valuable in cabinet-making.

**Order Rutaceæ.**—The Rue Family. Shrubs and trees, rarely herbs, with glandular-punctate heavy-scented foliage; leaves generally compound and alternate; stamens generally distinct. The order as here considered includes 650 known species, widely distributed in tropical

FIGS. 502-505.—ILLUSTRATIONS OF CITRUS AURANTIUM.



FIG. 502.



FIG. 503.

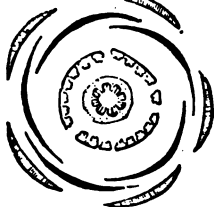


FIG. 504.



FIG. 505.

Fig. 502.—Section of flower. Magnified.

Fig. 503.—Part of androecium. Magnified.

Fig. 504.—Flower diagram.

Fig. 505.—Calyx and ovary. Magnified.

and temperate climates. Seven tribes, most of which were formerly considered to be orders, are recognized by Bentham and Hooker.

**Tribe Aurantieæ**, with actinomorphic, monoclinal flowers, baccate (berry-like) fruits, and seeds without endosperm. (Figs. 502-5.)

*Citrus Aurantium*, the Sweet Orange, is an Indian tree, now grown throughout all warm countries of the world for its well-known fruits.

*C. Limonum*, the Lemon, is a native of Northern India, now widely distributed. It was introduced into Europe during the Crusades.

Other species of *Citrus* yield valuable fruits, as *C. medica*, the Citron; *C. Limetta*, the Lime; *C. decumana*, the Shaddock; *C. Bigaradia*, the Seville or Bitter Orange, etc., etc.

The hard yellow wood of the Orange is valued for inlaying.

**Tribe Todalatieæ**, with actinomorphic, mostly diclinous flowers, coriaceous or baccate fruits, and seeds with endosperm.

*Ptelea trifoliata*, the Hop Tree, of the Eastern United States, *Skimmia Japonica*, a small Japanese shrub, and two species of *Phellodendron*, from Manchuria, are planted in gardens.

**Tribe Xanthoxyleæ**, with actinomorphic, mostly diclinous flowers, usually capsular fruits, and seeds mostly with endosperm.

*Xanthoxylum Americanum*, the Common Prickly Ash, of the Northern United States, and *X. Clava-Herculis*, the Southern Prickly Ash, of the Southern States, are ornamental shrubs, and are often planted.

**Tribe Boronieæ**.—Australian shrubs.

**Tribe Diosmeæ**, with actinomorphic, monoclinal flowers, capsular fruits, and seeds without endosperm.

Species of *Diosma* and *Barosma*, pretty African shrubs, are to be found in conservatories. From their leaves the drug Buchu is obtained.



Fig. 506. — Diagram of the flower of *Dictamnus Fraxinella*, the interposed stamens (of later origin) slightly shaded.—After Sachs.

**Tribe Ruteæ**, with generally actinomorphic, monoclinal flowers, capsular fruits, and seeds with endosperm. (Fig. 506.)

*Ruta graveolens*, the Common Rue of the gardens, is a native of Southern Europe and Western Asia.

*Dictamnus Fraxinella*, *Fraxinella*, or the Gas Plant, is a heavy-scented ornamental plant, whose glandular foliage secretes a volatile oil, which is said sometimes to flash into flame when a light is brought near to it. (Figs. 116-7.)

**Tribe Cuspariæ**, with zygomorphic, monoclinal flowers, capsular fruits, and seeds without endosperm.

*Galipea cusparia*, a large tree of Guiana and Brazil, furnishes a bitter medicinal bark, known as Angustura Bark.

**Order Geraniaceæ**.—The Geranium Family. Mostly herbs (rarely shrubby or arborescent); leaves opposite or alternate, simple or compound; stamens more or less united below; species, 750, mostly of temperate and sub-tropical climates.

Many are cultivated as ornaments.

*Impatiens Balsamina*, the Garden Balsam, or Touch-Me-Not, sometimes erroneously called "Lady's Slipper," is a well-known annual from India, which has been cultivated for more than two hundred and fifty years. The name Touch-Me-Not (referring to its elastically opening fruits) is shared by two pretty native species. (Fig. 507.)

*Oxalis* contains several native species of Wood Sorrel, all of which

are pretty, and many exotic species (mostly South African), which are in common cultivation.

*Tropæolum majus*, the Nasturtium, from South America, is in common cultivation. The edible tuberous roots of *T. tuberosum*, of Peru, are used instead of potatoes in some parts of South America.

*Pelargonium* is another South African genus, which has furnished us with many fine greenhouse and garden flowering plants, most of which are erroneously called Geraniums.

The true Geraniums belong to the genus of that name represented in this country by eight or nine wild species.

*Erodium cicutarium*, the Alfilaria, of California, "is a valuable and nutritious forage plant reputed to impart an excellent flavor to milk and butter." (*Brewer*.)

**Order Zygophyllaceæ.**—Shrubs and herbs (a few trees), with opposite compound leaves; stamens distinct; species, about 100, almost confined to the tropics.

*Guaiacum officinale*, the Lignum-vitæ, of the West Indies, is a tree six to nine metres (20 to 30 feet) high, whose dark red, almost black, heart-wood is exceedingly hard; it furnishes the best material for ship's blocks, pulleys, etc.

*Larrea Mexicana*, the

Creosote Bush of Arizona, is a curious diffusely branched evergreen shrub, with a very strong creosote-like odor.

**Order Malpighiaceæ.**—Trees and shrubs, often climbing; natives for the most part of the tropics; species, 580, some of which are cultivated in greenhouses.

**Order Humiriaceæ.**—Balsamic trees and shrubs of tropical America and Africa.

**Order Linaceæ.**—The Flax Family. Herbs, shrubs, and a few trees, with alternate or opposite simple leaves; stamens more or less united below; species, 135, widely distributed in temperate and tropical climates.

The most important plant of the order, and one of the most important in the vegetable kingdom, is the Flax, *Linum usitatissimum*, cultivated from time immemorial for its fibres, called linen (the best fibres

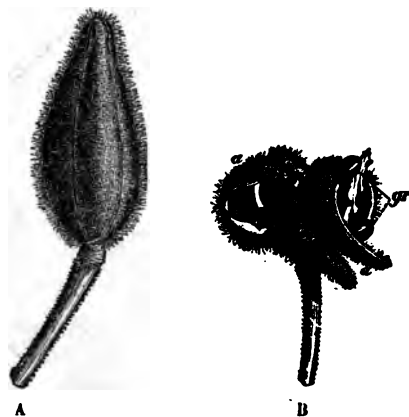


Fig. 507.—A, the fruit of *Impatiens Balsamina*. B, the same after dehiscence; a, carpels; gr, seeds.  
—After Duchartre.

of the cortical part of the stem). The mummy cloth of ancient Egypt is composed of flax fibres, and in the remains of the "lake dwellings" in Switzerland, fragments of linen cloth have been found. The plant appears to be indigenous in the south of Europe, as well as in the regions eastward in Asia; it is now cultivated throughout the North and South Temperate Zones. The seeds are rich in oil, which is extracted by pressure, producing the Linseed-oil of commerce; the

FIGS. 508-10.—ILLUSTRATIONS OF LINUM USITATISSIMUM.



FIG. 508.

Fig. 508.—Inflorescence.  
Fig. 510.—Diagram of flower.

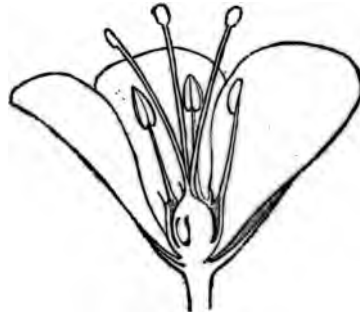


FIG. 509.

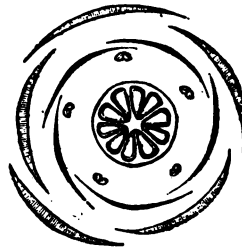


FIG. 510.

Fig. 509.—Section of flower. Magnified.

compressed refuse is called oil-cake, and is much used as food for cattle. (Figs. 508-10.)

*Erythroxylon Coca*, a South American shrub, is cultivated in Bolivia and New Granada for its stimulating leaves, which are chewed like tobacco.

**599.—Cohort XXXI. Malvales.** Flowers usually actinomorphic; stamens indefinite, generally monadelphous; ovary

superior, generally three- to many-celled ; seeds mostly with endosperm.

**Order Tiliaceæ.**—The Linden Family. Trees and shrubs (a few herbs), with mostly alternate simple leaves ; stamens distinct, or somewhat united below. Species 330, mostly tropical.

*Tilia Europæa*, the Lime or Linden Tree of Europe and Siberia, is a large and valuable tree, yielding a soft white wood much esteemed by carvers, musical instrument makers, and others. The fibre of its bark is used for making coarse mats, and its flowers produce a great quantity of most excellent honey.

*T. Americana*, the American Linden, Linn, or Basswood of the Eastern United States, resembles the preceding, and is equally valuable.

While the wood of our representatives of the order is soft, that of some tropical species is very hard—*e.g.*, *Sloanea dentata*, a West Indian tree, which has received the significant name of Break-Ax Tree.

*Corchorus capsularis*, a tall-growing annual of India, yields the Jute fibre now extensively used in making gunny bags, coarse carpets, and even fabrics of considerable fineness.

**Order Sterculiaceæ.**—Trees and shrubs (a few herbs) with alternate simple or compound leaves ; stamens more or less united into a tube. The 520 species contained in this order are almost entirely tropical.

*Theobroma Cacao*, the Chocolate Tree of tropical America, attains a height of five to six metres (16 to 20 ft.), and bears elongated ribbed

FIGS. 511-513.—ILLUSTRATIONS OF THEOBROMA CACAO.

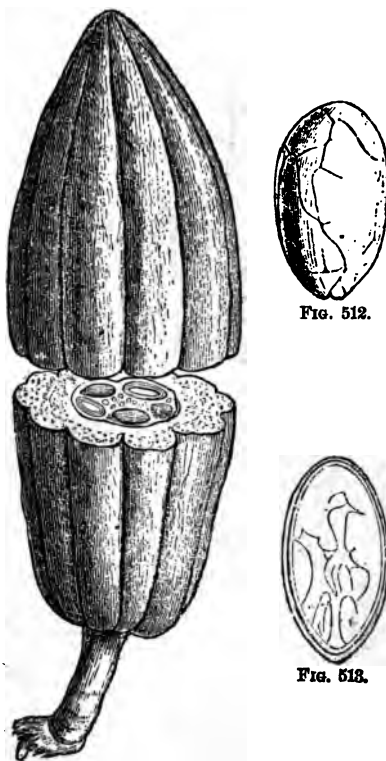


FIG. 511.

FIG. 511.—Fruit ( $\frac{3}{4}$  natural size).

FIG. 512.—Seed. Magnified.

FIG. 513.—Seed cut vertically. Magnified.

fleshy fruits, each containing fifty or more oily seeds (Figs. 511-13). The seeds are roasted and then ground, and made into a paste and dried, constituting the Chocolate or Cocoa of commerce, according as vanilla, sugar, and other substances are, or are not added. Chocolate and Cocoa contain *Theobromine* ( $C_7 H_8 N_4 O_2$ ), an alkaloid similar to Caffeine.

**Order Malvaceæ.**—The Mallow Family. Herbs, shrubs, and trees, with alternate simple leaves; stamens indefinite, united into a tube;

FIGS. 514-19.—ILLUSTRATIONS OF MALVACEÆ (*Malva sylvestris*).

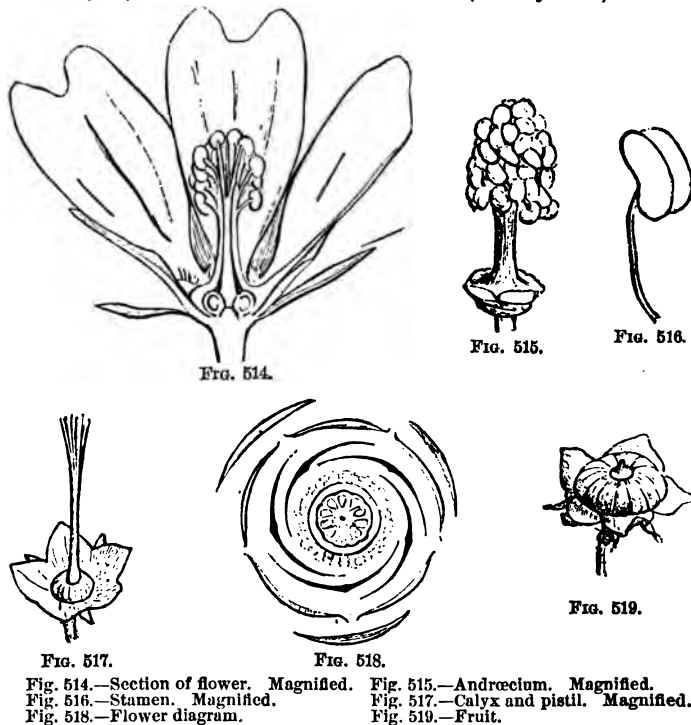


Fig. 514.—Section of flower. Magnified. Fig. 515.—Andræcium. Magnified.  
Fig. 516.—Stamen. Magnified. Fig. 517.—Calyx and pistil. Magnified.  
Fig. 518.—Flower diagram. Fig. 519.—Fruit.

anthers one-celled. Species about 700, widely distributed, but most abundant in tropical regions. (Figs. 514-19.)

*Gossypium herbaceum*, the common Cotton Plant of tropical and sub-tropical countries, was probably derived originally from some part of India. Its culture by the East Indians and Egyptians was known many centuries before the Christian era. In England the manufacture and use of cotton cloth began during the latter part of the sixteenth

century. The culture of cotton in North America dates from almost the first settlements in the Southern States, and the cotton crop is now more valuable than the product of any other single cultivated plant in the United States. It is extensively cultivated in the West Indies, Brazil, Egypt, and India.

The fibre of cotton consists of greatly elongated hairs (trichomes), which develop in great numbers upon the outer surface of the seed-coats; these are at first cylindrical, but upon drying, as the seed-pod approaches maturity, they collapse and appear flat and more or less bent and twisted.

Some East and West Indian trees of the genus *Bombax* produce an abundance of a similar fibre, which is fine and silky, hence the trees are known as Silk Trees. It is said, however, that the fibre cannot be woven, and it is at present only used for stuffing cushions, etc.

The bast fibres of the stems of some species are useful. Species of *Sida* in India, China, and Australia, of *Plagianthus* in New Zealand, and of *Thespesia* and *Hibiscus* in tropical America, are thus used; from the last the fibre called Cuba Bast is obtained.

*Hibiscus esculentus*, the Okra or Gumbo of tropical America, produces mucilaginous edible pods, which are much used in the Southern United States.

Species of *Durio* in the Malay Archipelago, and of *Matisia* in New Granada, furnish the inhabitants of those countries with valuable fruits. The wood of most of the species of the order is very soft and compressible; this is particularly the case with a West Indian tree, *Ochroma Lagopus*, whose wood, known as Cork Wood, has been used as a substitute for cork.

The Baobab Tree of tropical Africa is remarkable for the enormous size of its rounded spreading top and the thickness of its short stem.

Among the more common ornamental plants of the order are Mallows (*Malva*), Rose Mallow (*Hibiscus*), Hollyhock (*Althæa*), *Callirhoe*, etc.

**600.—Cohort XXXII. Guttiferales.** Flowers actinomorphic; stamens indefinite; ovary superior, three- to many-celled.

**Order Chlœnaceæ.**—A few shrubs and trees of Madagascar.

**Order Dipterocarpeæ.**—Tropical trees (rarely shrubs), about 112 in number, the most important of which is *Dryobalanops Camphora*, the Kapor or Camphor Tree of Borneo and Sumatra, which attains a height of forty metres (130 ft.), and yields a hard red timber used in boat-building. Its resin is called Sumatra Camphor, and is much used in China and Japan.



Fig. 520.—Flower diagram of *Gordonia Lasianthus*.



**Order Ternstroemiaceæ.**—Trees and shrubs with alternate (rarely opposite) leaves, and mostly monoclinal axillary or racemed flowers. Species 260, mostly tropical. (Figs. 520 and 521-5.)

Several ornamental species are indigenous to the Southern United States—e.g., the Loblolly Bay (*Gordonia Lasianthus*, Fig 520), a tree nine to fifteen metres (30 to 50 ft.) high; *G. pubescens*, the Mountain Bay; and two shrubby species of *Stuartia*.

The most common exotic species cultivated for ornament is the Camellia (*Camellia Japonica*) a well-known hot-house shrub from China and Japan.

The Tea Tree (*Camellia Chinensis* or *Thea Chinensis*) is an evergreen tree three to five metres high, and a native, probably, of Southern and Eastern Asia. It has been cultivated for ages by the Chinese, and has lately been introduced to a limited extent into other countries. In preparing the leaves they are carefully picked, and then are subjected to alternate drying, pressing, rolling and airing until the proper chemical changes have taken place, and a sufficient part of the water is driven off. The different kinds and qualities of tea depend upon the rapidity of the process, and also upon the age of the leaves used, the more rapid process and the younger leaves producing the finer *green* teas, the slower process and older leaves producing the *black* teas. Somewhat appears also to depend upon the variety of the plant, there being, it is generally admitted, two varieties or races, viz., var. *viridis* and var. *Bohea*.

Tea leaves after preparation contain the alkaloid Caffeine ( $C_8H_{10}N_4O_2 + H_2O$ ), which also occurs in roasted coffee.

**Order Guttiferæ.**—Trees and shrubs with yellowish or greenish resinous juice, opposite leaves, and mostly diclinous flowers. Species 230, all tropical.

*Garcinia Morella*, a small tree of Siam, produces Gamboge, a valuable color used in painting. Incisions are made into the bark, and the juice which exudes is gathered and dried, constituting the crude Gamboge.

The Mangosteen, a fruit about as large as an apple, and considered

FIGS. 521-5.—ILLUSTRATIONS OF CAMELLIA CHINENSIS.

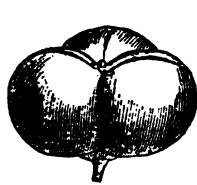


FIG. 521.



FIG. 522.



FIG. 524.

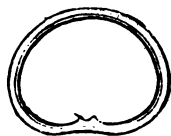


FIG. 523.



FIG. 525.

Fig. 521.—Ripe fruit. Magnified.  
Fig. 522.—Seed. Magnified.  
Fig. 523.—Section of seed. Magnified.  
Fig. 524.—Embryo. Magnified.  
Fig. 525.—Half embryo, inner face. Magnified.

to be one of the most delicious of all fruits, is produced by *Garcinia Mangostana*, a small tree of the Moluccas.

The fruit of *Mammea Americana*, a tall West Indian tree, is known as the Mammee Apple. It is as large as a melon, and its yellow pulp is said to be delicious.

A Central American species of *Calophyllum* yields a pale reddish, very durable timber known as Santa Maria wood.

**Order Hypericaceæ.**—Herbs and shrubs (a few trees) with opposite glandular-punctate leaves, and monoclinous flowers. Stamens united into three or five bundles (Fig. 526). Species 210, mostly found in temperate climates.

Our species are all herbs or low shrubs, belonging to the genera *Hypericum* and *Ascyrum*.

A species of *Cratogeomys*, in tropical India, is a large tree with dark brown wood.

**Order Elatinaceæ.**—Containing a few marsh plants.

**601.—Cohort XXXIII. Caryophyllales.** Flowers actinomorphic; stamens generally definite, usually as many or twice as many as the petals; ovary superior, one-celled; placenta usually central and free; seeds with endosperm.

**Order Tamariscineæ.**—Mostly shrubs of the Old World, with minute alternate simple leaves.

Of the forty species, but three are found in the New World, and all these reach our extreme Southwestern border.

*Tamarix Gallica*, the Tamarisk of Europe to India, is a common ornamental shrub in this country.

**Order Portulacaceæ.**—Herbs and a few small shrubs, with alternate or opposite leaves; sepals generally two. Species 125, widely distributed, but most abundant in the New World.

*Portulaca oleracea*, the common Purslane, is an East Indian, or possibly South European weed. It was formerly used as a pot herb.

*P. grandiflora*, the Portulaca of the gardens, is a pretty flowering annual.

*Claytonia* and *Calandrinia*, which have many native representatives, are ornamental.

**Order Caryophyllaceæ.**—The Pink Family. Mostly herbs with opposite leaves; sepals four or five, free or united into a tube; placenta central. Species 800, distributed throughout the world, but most abundant in Arctic, Alpine, European, and Western Asiatic countries.

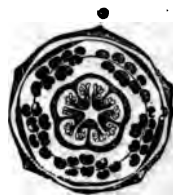


Fig. 526.—Diagram of the flower of *Hypericum calycinum*.—After Sachs.

Aside from the ornamental species and the weeds, the order possesses no plants of much economic importance.

The roots of *Saponaria officinalis* contain Saponin, and are detergent, but not sufficiently so to be much used.

Among the ornamental plants are the Carnations and Clove Pinks (*Dianthus* sp.), the Mullein Pink (*Lychnis*), Catchfly (*Silene*), Bouncing Bet (*Saponaria*), *Gypsophila*, etc.

Among the weeds are species of *Cerastium* (Fig. 527), *Spergula*, and

the Corn Cockle, *Lychnis Githago*.

The latter is often quite abundant in wheat fields, to the great detriment of the flour manufactured from the wheat.

**Order Frankeniaceæ.**—Maritime herbs and low shrubs resembling Caryophyllaceæ, but with parietal placentæ.

**602. — Cohort XXXIV. Polygalales.** Flowers actinomorphic or zygomorphic; stamens definite, as many as or twice as many as the petals; ovary usual-

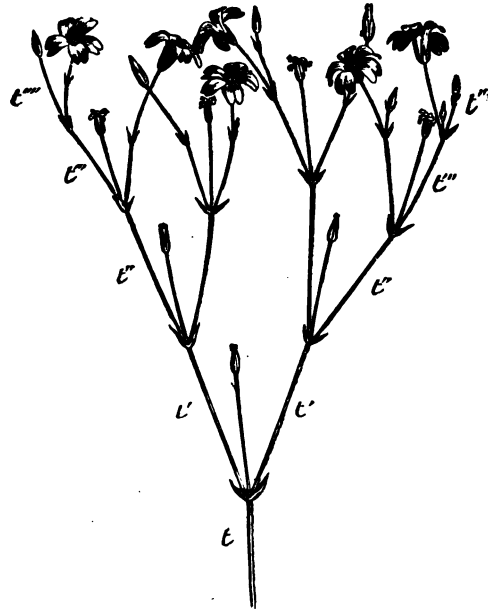


Fig. 527.—Inflorescence of *Cerastium collinum*. *t*, primary axis; *t'*, secondary axes; *t''*, tertiary axes; *t'''*, quaternary axes; *t''''*, quinary axes.—After Duchartre.

ly two-celled; seeds mostly with endosperm.

**Order Vochysiaceæ.**—Trees with a resinous juice, and opposite or verticillate leaves; flowers zygomorphic. Species about 100, confined to tropical America.

*Vochysia Guianensis*, of Guiana, furnishes the Copai-ye Wood, there used for making boat-oars, the staves for sugar hogsheads, etc.

**Order Polygalaceæ.**—Mostly herbs with alternate leaves; flowers zygomorphic. Species 400, distributed throughout temperate and tropical countries.

A bitter principle, which is sometimes emetic and purgative, pervades the order.

Some South African species of *Polygala* are grown as ornamental plants in conservatories. A few have a little reputation as medicines.

**Order Tremandreeæ**, containing a few Australian shrublets.

**Order Pittosporaceæ**.—Trees and shrubs with alternate leaves, and actinomorphic flowers; petals cohering into a tube. Species ninety, of Africa, India, China, and Australia.

*Pittosporum Tobira* is a common plant in conservatories.

*P. undulatum*, of Australia, attains a height of twenty to twenty-five metres (70 to 80 ft.), and its wood resembles Boxwood.

Climbing species of *Sollya* and other genera are grown in green-houses.

**603.—Cohort XXXV. Parietales.** Flowers actinomorphic or zygomorphic; stamens definite or indefinite; ovary usually one-celled, with parietal placentæ.

**Order Bixineæ**.—Trees and shrubs with alternate simple leaves, actinomorphic flowers, and generally indefinite stamens; seeds with endosperm. Species 160, mostly tropical.

One or two species of *Amoreuxia* barely reach our extreme South-western border.

*Bixa Orellana*, a small South American tree now cultivated in many tropical countries, produces fruits whose orange-red pulp when prepared and dried is the valuable dye known as Arnotto.

The fruits of some species are eaten, and a few gums are derived from others.

**Order Canellaceæ**, containing four or five species of tropical trees. *Canella alba* yields Canella Bark, which is used in medicine.

**Order Violaceæ**.—The Violet Family. Herbs and shrubs with mostly alternate leaves, zygomorphic flowers, and definite stamens; seeds with endosperm. Species 240, widely distributed in temperate and tropical regions.

An emetic and laxative principle is common in the plants of this order.

The genus *Viola*, the Violets, includes about half of the species of the order; many of these are indigenous to parts of the United States, and nearly all of these, as well as the exotic species, are ornamental.

*V. odorata*, the Sweet Violet, and *V. tricolor*, the Pansy, both natives of Europe, are common in gardens and door-yards. Of the latter there are almost numberless varieties.

Several Brazilian shrubby plants of the order are cultivated in green-houses.

The root of *Ionidium Ipecacuanha*, a Brazilian shrub, is the White Ipecacuanha of pharmacy.

A Peruvian tree, *Leonia glycyarpa*, produces edible pulpy fruits as large as a peach.

**Order Cistaceæ.**—Herbs and shrubs with actinomorphic flowers. Species about sixty, mostly of temperate climates.

A shrubby *Cistus* from the South of Europe is common in green-houses.

Some of our native species of Frostweed (*Helianthemum*) and *Hudsonia* are pretty.

**Order Resedaceæ.**—Herbs (a few shrubs) with alternate leaves, mostly zygomorphic flowers, indefinite stamens, and seeds without endosperm. Species twenty to twenty-five, confined to the Mediterranean region and South Africa, with the exception of two or three spe-

FIGS. 528-30.—ILLUSTRATIONS OF CRUCIFERÆ (WALLFLOWER).

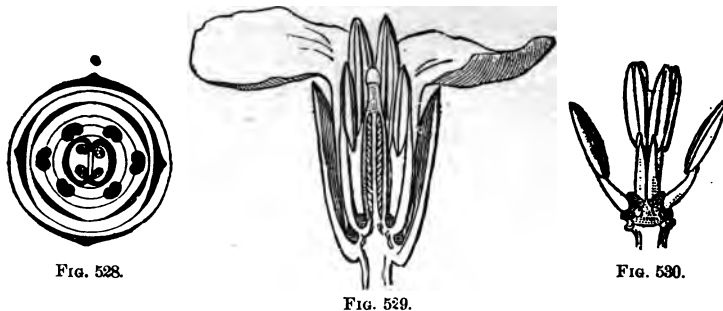


Fig. 528.—Flower diagram.

FIG. 529.

Fig. 529.—Section of Flower. Magnified.

Fig. 530.—Androecium. Magnified.

cies which reach India, one of which (*Oligomeris subulata*) extends to California.

*Reseda odorata* is the well-known Mignonette, probably a native of the Eastern Mediterranean region.

The foliage of *R. luteola*, an annual of Europe called Dyers' Weed or Weld, furnishes an important yellow dye.

**Order Capparidaceæ.**—Herbs, shrubs and trees with mostly alternate leaves, actinomorphic flowers, mostly indefinite (never tetradynamous) stamens, and seeds without endosperm. Species 300, mostly tropical or sub-tropical. An acrid volatile principle prevails in the order.

*Capparis spinosa*, a stiff prickly-branched shrub of the Mediterranean region, is extensively cultivated in Europe for its unopened flower buds, which preserved in vinegar constitute the condiment known as Capers.

*Cleome integrifolia*, a native of the Western Mississippi Valley, and

*C. pungens*, of South America, are fine flowering plants cultivated in gardens.

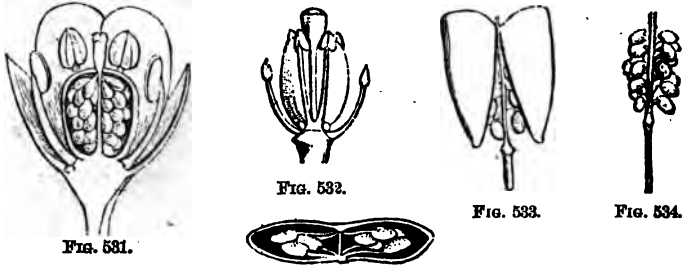
**Order Cruciferae.**—The Crucifer Family. Herbs and a few low shrubs with actinomorphic flowers, tetradynamous stamens, and seeds without endosperm (Figs. 528–41). This large order includes 172 genera and about 1200 species, which are distributed throughout the temperate regions of the world, but are most abundant in Southern Europe and Asia Minor. The prevailing principle in the order is pungent and stimulant.

The order is divided by Bentham and Hooker into ten tribes, distinguished by the shape of the fruit and the disposition of the cotyledons in the seed, whether incumbent or accumbent (Figs. 536 to 541).

The order furnishes a few food plants of some importance.

*Brassica oleracea*, a wild plant of the Atlantic coast of Europe, is

FIGS. 531-5.—ILLUSTRATIONS OF CRUCIFERÆ (SHEPHERD'S PURSE).



- Fig. 531.—Vertical section of flower. Magnified.  
 Fig. 532.—Pistil and stamens. Magnified.  
 Fig. 533.—Ripe capsule splitting open. Magnified.  
 Fig. 534.—Seeds on placenta, the capsule-valves removed. Magnified.  
 Fig. 535.—Cross-section of capsule. Magnified.

probably the original form from which have been derived by long cultivation the following races, which are now almost, if not quite, entitled to be regarded as species, differing as they do fully as much from one another as many wild species :

*Race I. Cauliflower*, in which the thickened and consolidated flower peduncles constitute the edible portion of the plant.

*Race II. Bore Cole or Kale*, in which the expanded but tender leaves of the tall stem are the edible parts.

*Race III. Brussels Sprouts*, resembling the last, but with thick edible buds in the axils of the leaves.

*Race IV. Cabbage*, in which the leaves do not expand, but form a single large thick edible bud or "head."

*Race V. Kohl-Rabi*, in which the short and few-leaved stem becomes thick, bulbous, and edible.

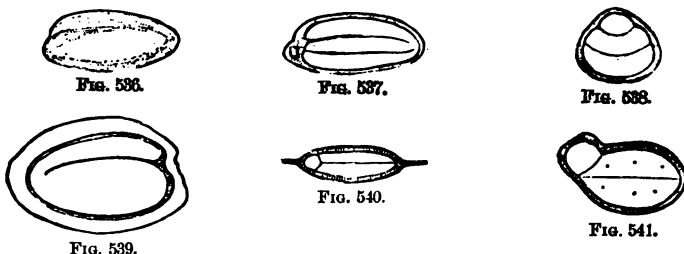
*B. campestris*, of the same regions as the preceding, has given rise to the various kinds of Turnips. Colza and Rape also are probably varieties; the latter are extensively cultivated in Europe for their oily seeds, from which useful oils are obtained by pressure.

*Raphanus sativus*, the Radish, is a native of China.

*Nasturtium Armoracia*, the Horseradish of Europe, has long been cultivated for its pungent roots, which are used as a condiment. According to Dr. Gray, the plant, for some unknown reason, does not produce seeds in this country.

*N. officinale*, Water Cress of Europe, and now run wild in many parts

FIGS. 536-41.—SEEDS OF CRUCIFERÆ.



- FIG. 536.—Seed of *Erysimum*. Magnified.  
 FIG. 537.—Longitudinal section of seed. Magnified.  
 FIG. 538.—Cross-section of seed, showing incumbent cotyledons. Magnified.  
 FIG. 539.—Longitudinal section of seed of *Arabis*. Magnified.  
 FIG. 540.—Cross-section of seed of *Arabis*, accumbent cotyledons. Magnified.  
 FIG. 541.—Cross-section of seed of *Barbarea*, imperfectly accumbent cotyledons. Magnified.

of the United States, and many other rapidly growing foreign and native species, are used as salads.

*Brassica alba*, White Mustard, and *B. nigra*, Black Mustard, both natives of Europe, are grown for their seeds, which when ground constitute the common condiment Mustard. It is also of considerable value in medicine.

*Isatis tinctoria*, a tall-growing European biennial, was formerly extensively grown for the blue dye obtained from it.

The most important ornamental plants of the order are the Wall-flower (*Cheiranthus*), Gilly Flower or Brompton Stock (*Matthiola*), Rocket (*Hesperis*), Candytuft (*Iberis*), Honesty (*Lunaria*), Sweet Alyssum (*Alyssum*), etc., etc.

Several of the species are troublesome weeds—e g., Shepherd's Purse (*Capsella*), which has come to this country from the Old World; Pepper-grass (*Lepidium*), native and introduced; False Flax (*Camelina*) from Europe; Charlock and Mustard (*Brassica*) from Europe.

The curious plant called the Rose of Jericho (*Anastatica hierochuntica*), often sold as a curiosity, is a small annual, native of Arabia, Egypt, and Syria. The mature plant after ripening its seeds contracts into a rounded mass, and is uprooted and blown about by the winds. When, however, the dry and dead plant is moistened, it expands, clos-

FIGS. 542-5.—ILLUSTRATIONS OF *PAPAVER RHÆAS*.

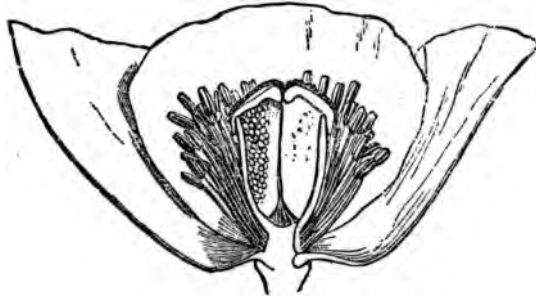


FIG. 542.



FIG. 543.

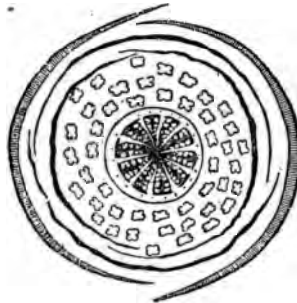


FIG. 544.



FIG. 545.

Fig. 542.—Vertical section of flower. Magnified.  
Fig. 543.—Pistil and stamen. Magnified.

Fig. 544.—Flower diagram.  
Fig. 545.—Ripe fruit.

ing again when dry. On this account it is also called the Resurrection Plant.

**Order Fumariaceæ.**—Herbs with watery juice, alternate, usually divided leaves; flowers zygomorphic; stamens definite, four, five or six and diadelphous. Species about 100, natives of warmer portions of the North Temperate Zone and of South Africa. They possess an acrid and astringent principle.

Bentham and Hooker, in the "Genera Plantarum," unite this order



with the next, but this arrangement has not generally been adopted by botanists.

*Dicentra spectabilis*, the Bleeding Heart, a showy Chinese species, is in common cultivation for its heart-shaped pink-red flowers. Our native species, *D. Canadensis* and *D. Cucullaria*, are pretty, and are sometimes cultivated.

Climbing Fumitory (*Adlumia cirrhosa*) is a delicate native climber, also cultivated in gardens.

**Order Papaveraceæ.**—The Poppy Family. Herbs and a few low shrubs, with a milky or colored juice, alternate leaves, and actinomorphic flowers; stamens indefinite, seeds with endosperm (Figs. 543-5). The order as here constituted includes about sixty species, natives, for the most part, of the North Temperate Zone. They contain a narcotic principle.

The most important plant of the order is the Opium Poppy (*Papaver somniferum*), a native of many parts of the Old World, and now cultivated in Southern Europe and India. Opium is obtained from it by scarifying the full-grown but still green capsules: the juice which exudes soon hardens and is then collected, constituting in this state the crude Opium of commerce.

Opium contains from six to twelve per cent of an alkaloid substance, Morphia ( $C_{17}H_{15}NO_2 + H_2O$ ), to which its narcotic properties are mainly due.

Other species of *Papaver*, several of which are in common cultivation in flower-gardens, contain Opium, but it is not considered to be as valuable as that from the Opium Poppy.

*Sanguinaria Canadensis*, the Blood-root, a pretty native plant of the Eastern United States, contains in its red juice narcotic properties similar to those of Opium.

Among the ornamental plants besides Poppies and Blood-root, are *Bocconia*, a tall-growing Chinese perennial, *Argemone*, from Mexico, and *Eschscholtzia*, from California.

**Order Sarraceniacæ.**—Perennial marsh herbs, with radical tubular leaves, solitary actinomorphic flowers; stamens indefinite; seeds with endosperm. Species ten, nine of which are natives of the United States. (Figs. 546-7.)

*Sarracenia purpurea*, the common Pitcher Plant of the Northern and Eastern United States, inhabits peat bogs and "cranberry marshes." Its open, pitcher-like leaves contain water, in which many decaying insects may always be found. The structure of the interior surface of the pitcher is such as to make it exceedingly difficult for insects, when once in it, to escape, being lined for some ways down with myriads of short and sharp stiff bristles which point downwards. Without doubt these plants are nourished by the decaying insects in their leaves, and to this extent they are to be regarded as saprophytes. In some Southern species, as, for example, *S. variolaris* and *S. psittacina*, the pitcher is

covered by a hood much as in *Nepenthes* (page 483), and in these water is also found (undoubtedly a secretion in these cases) in which are many decaying insects. Moreover, in these and some other species drops of a sweetish honey-like substance are secreted on the leaves, which apparently serve to lure insects to the margin of the pitcher.

The California Pitcher Plant (*Darlingtonia Californica*) of the northern part of California, has long tubular leaves which are arched over at



Fig. 546.—Flower and leaves of *Sarracenia purpurea*.  $\frac{1}{2}$  natural size.—From Le Maout and Decaisne.



Fig. 547.

the top, so that the orifice opens downward; from the orifice there hangs down a forked blade, which is more or less covered with a sweet secretion, and within the tube there is always found water more or less filled with insects. The arrangement here is evidently one well fitted to capture insects, which, after maceration, are absorbed for the nourishment of the plant.

The third genus, *Heliamphora*, contains a single species, native of Venezuela.

**604.—Cohort XXXVI. Ranales.**—Flowers mostly actinomorphic; stamens rarely definite; carpels free, very rarely connate; seeds with copious endosperm.

**Order Nymphaeaceæ.**—The Water Lily Family. Aquatic herbs, with usually floating peltate leaves; flowers solitary, monoclinous; petals and stamens generally numerous; carpels mostly united, rarely free. Species thirty-five, widely distributed.

*Nelumbium luteum*, the Yellow Water Lily, or Water Chinquepin, is common in the ponds and rivers of the Mississippi Valley and the Southern States. Its nut-like fruits, which are imbedded in the large top-shaped receptacle, are edible. (Figs. 548-9.)

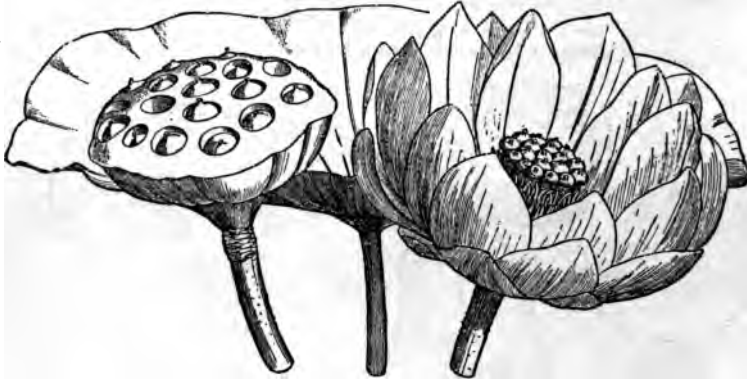


Fig. 548.—Leaf, flower, and fruiting receptacle of *Nelumbium luteum*.  $\frac{1}{2}$  natural size.—From Le Maout and Decaisne.

*N. speciosum*, the only other species of the genus, occurs in Southern and Southeastern Asia.

*Nymphaea odorata* and *N. tuberosa* are the well-known White Water Lilies of the Eastern United States. *N. cœrulea* and *N. Lotus* are common on the Nile.



Fig. 549.—Section of the young receptacle and carpels.

*Victoria regia*, the Victoria Lily of the Amazon Valley in South America, is remarkable for the size of its leaves and flowers; the former are peltate, perfectly circular, and two metres or more in diameter, and the slender petioles are often three metres long; the flowers resemble those of our White Water Lilies, and are twenty-five to thirty centimetres in diameter; upon first opening they are pure white, but upon opening a second time they are of a pink color.

**Order Berberidaceæ.**—The Barberry Family. Herbs and shrubs with alternate or radical leaves; flowers monoclinal or declinal; petals and stamens few; carpels one to three, rarely more, distinct. Species about 100, mostly natives of cool climates.

*Berberis vulgaris*, the Barberry of Europe (Figs. 550-3), is cultivated as an ornamental shrub, as well as for its edible acid berries. The flowers are interesting on account of their sensitive stamens, which

move quickly toward the pistil when touched at their bases by an insect searching for the honey secreted by glands upon the petals (Figs. 551-52).

*B. Canadensis*, of the Southern States, is much like the foreign species.

FIGS. 550-3.—ILLUSTRATIONS OF *BERBERIS VULGARIS*.

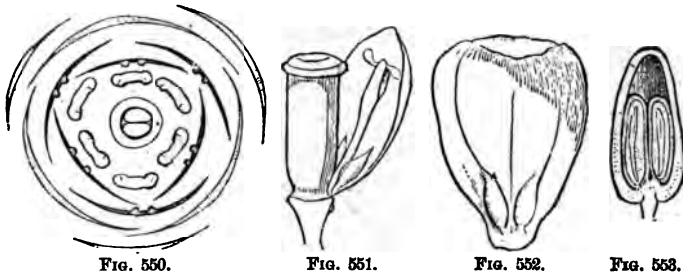


Fig. 550.—Flower diagram.  
Fig. 551.—Pistil, with a petal and stamen. Magnified.  
Fig. 552.—Upper side of a petal, showing its two glands. Magnified.  
Fig. 553.—Vertical section of ovary. Magnified.

Several evergreen species from the Rocky Mountains and Oregon, and one from Japan, are cultivated under the name of *Mahonia*.

*Podophyllum peltatum*, the May Apple of the Eastern United States, produces an edible, plum-shaped fruit. Its poisonous rootstocks are

FIGS. 554-8.—ILLUSTRATIONS OF *MENISPERMUM CANADENSE*.

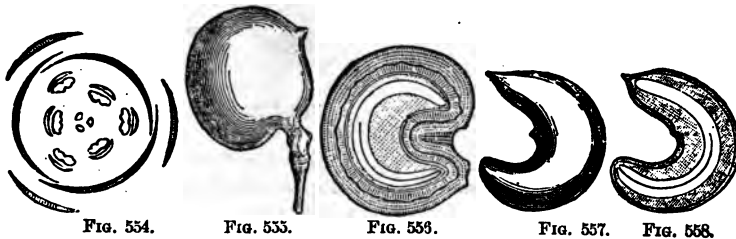


Fig. 554.—Diagram of male flower.  
Fig. 555.—Fruit. Magnified.  
Fig. 556.—Section of fruit. Magnified.  
Fig. 557.—Seed. Magnified.  
Fig. 558.—Section of seed. Magnified.

used somewhat in medicine. A second species occurs in the Himalayas.

*Caulophyllum thalictroides*, of the Eastern United States and also of Japan, is interesting on account of its young ovaries bursting open and allowing the ovules to develop into naked drupe-like seeds.

**Order Menispermaceæ.**—Woody twining plants, with alternate leaves; flowers diclinous; petals usually six, with a stamen before (opposite to) each one; carpels usually three, distinct and one-seeded. Species eighty to one hundred, principally tropical. They generally contain a bitter principle, which in some is tonic, in others narcotic, or even poisonous.

*Menispermum Canadense*, the Moonseed of the Eastern United States, is a beautiful climber deserving cultivation in ornamental gardens. Its only congener is a native of Eastern Asia. (Figs. 554-8.)

FIGS. 559-64.—ILLUSTRATIONS OF *ASIMINA TRILOBA*.



FIG. 559.



FIG. 560.



FIG. 561.

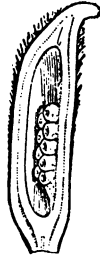


FIG. 562.



FIG. 563.



FIG. 564.

Fig. 559.—Section of flower. Magnified.

Fig. 560.—Flower diagram. Magnified.

Fig. 562.—Section of young carpel. Magnified.

Fig. 563.—Seed. Natural size.

Fig. 561.—Young carpel. Magnified.

Fig. 564.—Section of seed.

Two other genera, *Culycocarpum* and *Cocculus*, are represented in the United States.

Many of the Old World species are more or less in repute as furnishing medicines, but none are of sufficient importance to be particularly noticed.

**Order Anonaceæ.**—Trees and shrubs with alternate leaves; flowers trimerous; stamens indefinite, on a thickened receptacle; carpels generally indefinite. Species 400, mostly tropical. The bark generally contains an aromatic and stimulating, sometimes acrid principle.

*Asimina triloba*, the Papaw of the Southern United States, and extending to the Great Lakes, is a small tree producing edible pulpy fruits six to ten centimetres long. Several other smaller species of the same genus are common in the South. (Figs. 559-564.)

*Anona reticulata*, the Custard Apple, *A. Cherimolia*, the Cherimoya, *A. squamosa*, Sweet Sop, and *A. muricata*, Sour Sop, all cultivated in the West Indies and tropical America, produce edible fruits; the first is regarded by some people as one of the finest fruits in the whole world.

*Xylopia aromatica* is a tree of western tropical Africa, whose dry carpels are aromatic, and used as pepper under the name of Guinea Pepper. The ancients used this pepper ("Piper Æthiopicum") long before the introduction of Black Pepper.

FIGS. 565-7.—ILLUSTRATIONS OF *MAGNOLIA PURPUREA*.

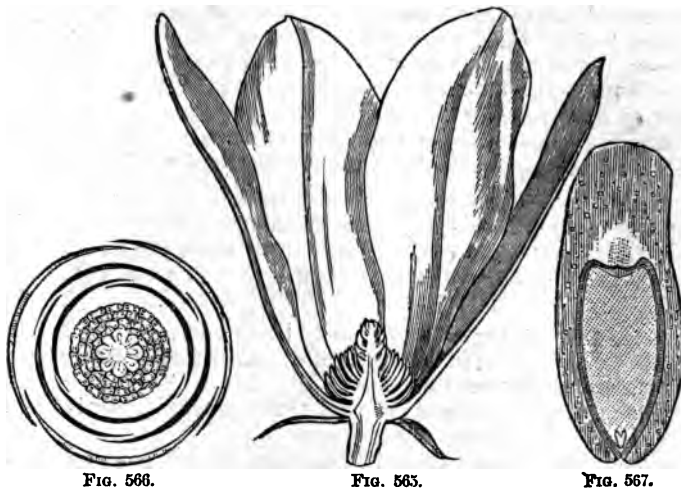


Fig. 565.—Flower cut vertically.

Fig. 566.—Flower diagram.

Fig. 567.—Section of seed. Magnified.

*Duguetia quitarensis*, a small tree of Guiana, supplies a tough elastic wood known as Lancewood.

**Order Magnoliaceæ.**—The Magnolia Family. Trees and shrubs with alternate simple leaves; flowers mostly monoclinal; petals and stamens indefinite; carpels usually indefinite. Species seventy, mostly of the tropical and sub-tropical parts of Asia and America. (Figs. 566-7.)

The genus *Magnolia* contains many beautiful trees, seven of which are natives of the Southern United States. Of these *M. acuminata*, the Cucumber Tree, extends north to the Great Lakes, and sometimes at-

tains a height of forty to fifty metres. Its light, whitish wood is valuable, and is much used for many purposes.

*M. grandiflora* is much like the preceding, but has larger flowers and evergreen leaves, the former being from fifteen to twenty-five centimetres in diameter. It grows only in the Southern States, where its timber is somewhat used.

*M. Umbrella* and *M. macrophylla* are named Umbrella Trees on account of the way in which their large leaves spread from the ends of the branches. The leaves of the last-named species are from fifty to eighty centimetres (20 to 30 in.) long, and the flowers are from thirty to thirty-five centimetres (12 to 14 in.) in diameter.

*M. glauca*, the Sweet Bay, is a shrubby species extending from Louisiana to Massachusetts, in the north near the coast only.

The foregoing and most, if not all, the remaining species are quite ornamental, and are planted wherever they will endure the winters.

*Liriodendron Tulipifera*, the Tulip Tree or Yellow Poplar of the Eastern United States, is one of our largest and most valuable timber trees. Its light, whitish or yellowish wood is much used in cabinet-making, coach-building, and for many other purposes.

*Magnolia conspicua* is the Yulan Tree of China. Other species of this genus occur in Japan, China, and the Himalaya region.

**Order Calycanthaceæ.**—Shrubs with opposite leaves; seeds without endosperm. Three species occur in the Southern United States, one in California, and one in Japan. This order, the structure of which cannot be discussed here, is evidently out of place in this Cohort.

**Order Dilleniaceæ.**—Shrubs, rarely trees, with alternate leaves; sepals five, petals five; stamens indefinite; ovaries usually distinct, one-celled. Species 180, mostly tropical.

Two Californian species of the genus *Crossosoma*, doubtfully referred to this order, are our only representatives.

Some of the Indian species of *Dillenia* and *Wormia* yield hard and valuable timber.

**Order Ranunculaceæ.**—Herbs, rarely shrubs, with mostly alternate or radical leaves; sepals usually five or fewer, deciduous, often petaloid; petals in one whorl, often wanting; carpels usually distinct. (Figs. 568-73.) Species about 500, most abundant in temperate and cold regions. The herbage usually possesses a considerable acidity.

Formerly many of the species were reputed to be of medicinal value, but at the present day they are but little used except by quacks. Several species, however, still retain their places in the pharmacopœias; among these are:

*Aconitum Napellus*, Monkshood or Aconite, a native of Europe, whose roots furnish the drug Aconite.

*A. ferox*, of upper India, supplies the people of that region with a virulent poison, with which they poison their arrows.

*Helleborus niger*, Black Hellebore, *H. fetidus*, Sinking Hellebore,

FIGS. 568-73.—ILLUSTRATIONS OF RANUNCULACEÆ (*Caltha palustris*).



FIG. 568.



FIG. 570.



FIG. 571.



FIG. 572.

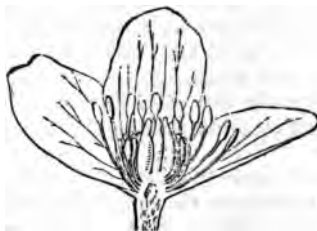


FIG. 569.



FIG. 573.

Fig. 568.—Flowering stem.  
Fig. 570.—Flower diagram.  
Fig. 572.—Seed. Magnified.

Fig. 569.—Vertical section of flower.  
Fig. 571.—Young carpel. Magnified.  
Fig. 573.—Section of seed. Magnified.

and *H. viridis*, Green Hellebore, all natives of Europe, furnish drastic and poisonous drugs.

Among the ornamental plants of the order may be mentioned the following :

*Anemone*, of several species, including our native Hepaticas, now placed in this genus.



*Adonis*, the Pheasant's Eye, of Europe.

*Aquilegia*, the Columbine, including our common Eastern species (*A. Canadensis*) and the Rocky Mountain Long Spurred Columbine (*A. cærulea*), as well as the common one of Europe (*A. vulgaris*).

*Clematis*, the Virgin's Bower, of many species, native and foreign, all pretty.

*Delphinium*, the Larkspur, of many species, mostly foreign.

*Nigella*, Love in a Mist, from the Old World.

*Pæonia*, the Peony, of several species, from Europe, Sibéria, and China.

*Ranunculus*, Buttercup, of several European species.

*Trollius*, Globe Flower, from Europe and Siberia.

Very few species afford nutritious products useful for food; the tuberous roots of a species of *Ranunculus* are gathered and eaten in some parts of Central Europe, and a few fleshy species (as, for example, *Caltha palustris*, *Ranunculus sceleratus*, etc.) are used to a limited extent as pot herbs.

**Fossil Dicotyledons.**—No Dicotyledons are known in the periods earlier than the Cretaceous. In this, however, many modern orders are represented. In the Cretaceous of the Western Territories of the United States Lesquereux describes\* one hundred species of Dicotyledons. Of these sixty belong to the Apetalæ, five to the Gamopetalæ, and thirty-five to the Choripetalæ (Polypetalæ). The Apetalæ include five species of *Populus*, six of *Salix*, eight of *Quercus*, six of *Platanus*, seven of *Sassafras*, etc. Among the remarkable fossils are a species of *Ficus* from Minnesota, two species of *Cinnamomum* from Kansas, and two of *Laurus* from Nebraska. The five species of Gamopetalæ represent the Ericaceæ (a single species of *Andromeda*), Ebenaceæ (two species of *Diospyros* from Kansas and Nebraska), and Sapotaceæ (two species, one a *Bumelia* from Nebraska and Minnesota). Among the species of Choripetalæ are five of *Magnolia*, two of *Liriodendron*, one of *Hedera*, one of *Prunus*, one of *Pirus*, etc., from Kansas, Nebraska, and Dakota.

In the Tertiary most of the more important orders of Dicotyledons are represented. Here, as in the Cretaceous, there is still a predominance of Apetalous species; thus in the Tertiary Flora of the Western Territories† there have been determined of the Apetalæ one hundred and twelve species, Gamopetalæ, nineteen, and Choripetalæ, seventy-nine. The Apetalæ are principally represented by the Myricaceæ (twelve species of *Myrica*), Betulaceæ, Cupuliferæ (a *Carpinus*, a *Corylus*, a *Fagus*, a *Castanea*, and eighteen species of *Quercus*), Juglandaceæ

\* "Contributions to the Fossil Flora of the Western Territories. Part I., The Cretaceous Flora," by Leo Lesquereux. Washington, 1874.

† Leo Lesquereux, op. cit. Part II., "The Tertiary Flora," 1878.

(a *Carya*, a *Pterocarya*, and seven species of *Juglans*), Salicaceæ (four species of *Salix* and twelve of *Populus*), Platanaceæ (five species of *Platanus*), Moraceæ (twenty-three species of *Ficus*), Lauraceæ (six species of *Laurus*, one of *Tetranthera*, and four of *Cinnamomum*).

The Gamopetalæ are represented by Caprifoliaceæ (nine species of *Viburnum*), Oleaceæ (four species of *Fraxinus*), Ebenaceæ (four species of *Diospyros*), and Ericaceæ (an *Andromeda* and a *Vaccinium*).

The principal orders of the Choripetalæ are Ampelidæ (one species of *Ampelopsis*, two of *Vitis*, and four of *Cissus*), Anacardiaceæ (five species of *Rhus*), Cornaceæ (four species of *Cornus*), Rhamnaceæ (ten species of *Rhamnus*, five of *Zizyphus*, three of *Paliurus*, and one of *Berchemia*), Illicineæ (four species of *Ilex*), Sapindaceæ (six species of *Sapindus*), Myrtaceæ (two doubtful species of *Eucalyptus*), Rosaceæ (a single species of *Cratagus*), Leguminosæ (a *Podogonium*, a *Cassia*, an *Acacia*, a *Mimosites*, and two *Leguminosites*), and Magnoliaceæ (four species of *Magnolia*).

## CHAPTER XXI.

### CONCLUDING OBSERVATIONS.

**605.—The Number of Species of Plants.**—It is impossible at the present time to give with even approximate accuracy the number of existing species of plants. In the first place, a great many species in all parts of the world are as yet undescribed; even in England, where the study of this branch of Botany has been most energetically pursued, many new species are discovered every year. In the central and western countries of the continent of Europe, as in England, while comparatively few flowering plants have escaped detection, there yet remain undescribed hundreds of species of the lower groups, and in the regions eastward there are doubtless many phanerogams as well as cryptogams which have not yet been enumerated. A complete "Flora of Europe" will probably be an impossibility for very many years. In Asia our knowledge of the plants is still more fragmentary. Japan and India, with parts of Asia Minor, are the best known botanically, but even in these regions our knowledge is almost entirely confined to the phanerogams and higher cryptogams. In Australia and the islands to the northward and in Africa, there are enormous tracts which have not yet been explored. In the New World, from Mexico southward, the descriptions and enumerations of the native plants are scattered through many works, not one of which approximates completeness even for comparatively small regions. In North America, the "Flora of North America," begun forty years ago, is yet unfinished, even for the flowering plants.\*

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\* "A Flora of North America," by John Torrey and Asa Gray. Vol. I., 1838-40. Vol. II. (in part), 1843. Resumed under the title of "A Synoptical Flora of North America," by Asa Gray, 1878.

In the second place, many of the so-called species in descriptive works are but varieties, while in other cases the same forms have been described under different names. This is true in all the groups of plants, and scarcely a monograph now appears in which there are not cases of the reduction of a supposed species to a synonym or variety.

**606.**—With these considerations in mind, we may examine the catalogues and make some general estimates. Steudel in 1824 catalogued in "Nomenclator Botanicus" 59,684 phanerogams and 10,965 cryptogams, making a total of 70,649. In the second edition, published in 1841, the number of phanerogams was increased to about 78,000. Lindley, in 1845, estimated the number of dicotyledons to be 66,488, the monocotyledons 13,952, and the cryptogams 12,480, making a total of 92,820. De Candolle's "Prodromus," begun in 1824 and continued to 1873, contains, according to Alph. De Candolle's historical note in Vol. XVII. of that work, descriptions of 58,446 dicotyledons and 429 gymnosperms.

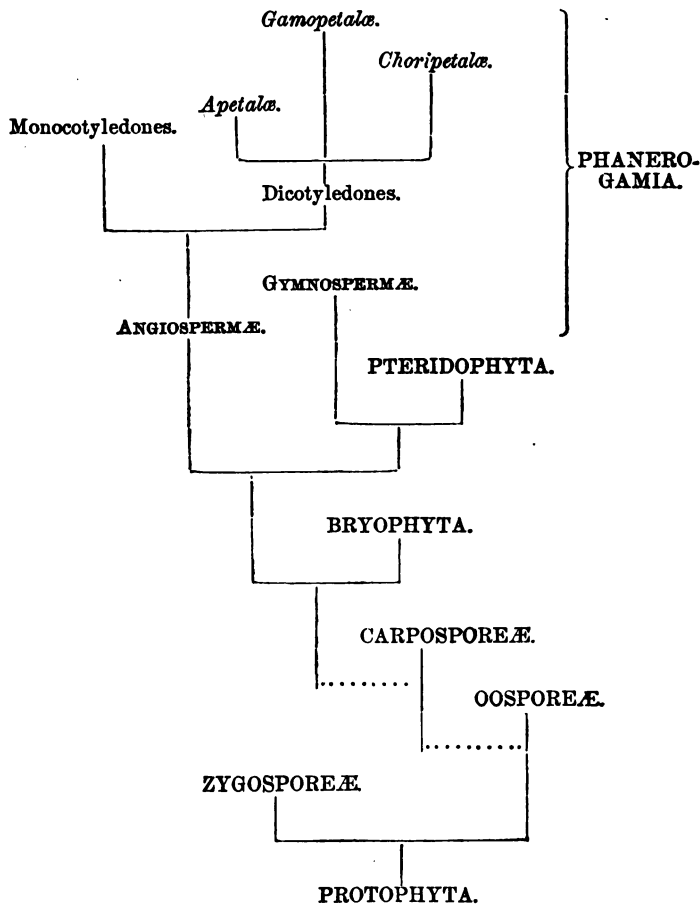
Duchartre estimates the known species of phanerogams at about 100,000, and of cryptogams at about 25,000, and ventures to place the whole number of species in the world at from 150,000 to 200,000. Dr. Gray quotes De Candolle's estimate of the known species of flowering plants, amounting to from 100,000 to 120,000, and says that "the larger number may perhaps include the higher orders of the flowerless series," and in speaking of the lower cryptogams says that at present "no close estimate can be well formed of the actual number of species."\*

**607.**—**The Affinities of the Groups of Plants.**—Many attempts have been made to construct diagrammatic figures which should indicate the affinities of the different groups of the vegetable kingdom. While it is impossible to do this with any great degree of accuracy, we may yet show in this way certain relations, more clearly than can be done otherwise. The subjoined diagram may be taken to indicate in a general way the writer's present notion of the affinities (*i.e.*,

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\* In his "Botanical Text-Book," 1879, Part I., p. 346, foot-note.

the genetic relations) of the seven great divisions of plants, so far as they can be shown upon a plane surface :



**608.—The Distribution of Plants in Time.** If we bring together what is yet known as to Fossil Botany (Phytopalæontology), as has been done by Schimper,\* we find that the

\* "Traité de Paléontologie Végétale," par W. Ph. Schimper. Paris, 1869 to 1874. This work of three large octavo volumes (aggregating 2696 pp.) and a quarto atlas of 110 plates is a most valuable one for the student of Phytopalæontology.

TABULAR VIEW OF THE DISTRIBUTION IN TIME OF THE DIVISIONS OF THE VEGETABLE KINGDOM.

	Recent.	Tertiary.	Secondary.	Primary or Palæozoic.	
Protophyta.	—	—			Recent.
Zygosporææ.	—	—	—		Pliocene.
Oosporææ.	—	—	—		Miocene.
Carposporeæ.	—	—	—	—	Eocene.
Bryophyta.	—	—			Cretaceous.
Pteridophyta.	—	—		—	Jurassic.
Phanerogamia	—	—	—	—	Triassic.
				—	Permian.
				—	Carboniferous.
				—	Devonian.
				—	Silurian.

Gymnosperms.  
Monocotyledons.  
Dicotyledons.

several Divisions of the Vegetable Kingdom are very unequally distributed in geologic time. Thus no traces of Protophyta have yet been discovered earlier than the Tertiary (Miocene), while the Zygosporæ appear to extend back to the Secondary (Jurassic), and the Oosporæ and Carposporæ to the Silurian. Bryophyta have not been detected in strata earlier than the Eocene (Tertiary), while Pteridophyta extend back to the Devonian. Of the Phanerogamia the Gymnosperms originated in the Devonian, the Monocotyledons in the Triassic, and the Dicotyledons in the Cretaceous. These facts may be more clearly shown by the table on the preceding page.

It must be borne in mind that our knowledge of fossil plants is as yet extremely limited, a comparatively small portion only of the earth's strata having hitherto been carefully examined. It is very probable that as we come to know more of the fossil remains of plants some or all of the lines in the table will be extended downward. On the other hand, we need not expect to find many remains of the exceedingly simple organisms which constitute the Protophyta, although they probably have existed in abundance since pre-Silurian times. So, too, few Zygosporæ have a sufficiently durable plant-body to allow them to be preserved in a fossil state. The softness of texture and easy perishability of the tissues of the Bryophyta, especially in the lower orders, probably accounts for the few fossil remains hitherto discovered. Doubtless we must in the same way account for the fact that most of the species of fossil Phanerogams are trees and shrubs; the softer tissues of the herbaceous species have yielded but few fossils as compared with the harder and denser ones of the ligneous species.

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